# PROCEEDINGS

OF THE

# Perthshire Society of Natural Science.

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*SESSIONS 1881–82 to 1885–86.*

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PERTH:
PUBLISHED BY THE SOCIETY
AT THE PERTHSHIRE NATURAL HISTORY MUSEUM.

MDCCCLXXXVI.

# PREFACE.

A WORD of explanation is necessary regarding the position which the present Volume occupies in the annals of the Society. In 1870 a small volume was published containing the Proceedings for the Session 1869-70. After that, a Magazine, the "SCOTTISH NATURALIST," was started by the Society, so that separate Proceedings were not again published until the present series was commenced, in 1881, about which time the "SCOTTISH NATURALIST" was transferred to other hands.

The Six Annual Parts which form this series have been denoted Volume I., but as it is not intended to continue the issue in its present form, the Volume is complete in itself.

These Proceedings have, for the most part, been reprinted from the reports of the meetings, &c., which have appeared in the "PERTHSHIRE CONSTITUTIONAL." This is the cause of their being printed in double-column pages. But a more serious draw-back to the system was that the selection and arrangement of the matter which were most suited for newspaper publication were not always the best adapted for the Proceedings of a Scientific Society. The Council have, therefore, decided to commence a new series of Transactions and Proceedings, which will be specially printed for the Society, under the supervision of a Publishing Committee.

November, 1886.

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[Part III. is denoted on the Cover, Volume II., Part III., instead of Volume I., Part III.]

# PROCEEDINGS

OF THE

# Perthshire Society of Natural Science.

VOLUME I. PART I.

1880–81.



PERTH:
PUBLISHED BY THE SOCIETY AT THE
PERTHSHIRE NATURAL HISTORY MUSEUM.

MDCCCLXXXI.

# PROCEEDINGS

OF THE

# Perthshire Society of Natural Science.



VOLUME I. PART I.

1880–81.



PERTH:
PUBLISHED BY THE SOCIETY AT THE
PERTHSHIRE NATURAL HISTORY MUSEUM.

MDCCCLXXXI.

# PROCEEDINGS

OF THE

# PERTHSHIRE SOCIETY OF NATURAL SCIENCE.

## SESSION 1880-81.

November 18th, 1880.

James Geikie, Esq., LL.D., F.R.S., President, in the Chair.

Dr Buchanan White exhibited the roots of a plant which had been found choking a large pipe which conveys water to mills at Blairgowrie. The pipe is about seven miles long, and is formed of the usual tile-pipes, fastened at the joints with Portland cement. The roots are said not to be fouud in the reservoir, but as they clearly have not arizen inside the pipe, it was suggested that there must be some openings by which they could find their way into it from the outside. On enquiry it was found that there were several leakages in the pipe, and it is by them that the roots must have entered, and then increased to such an extent as to choke the pipe. What the species is it is difficult to say from the specimens sent, but it is possible that it is a species of *Equisetum*—a plant which has been found to cause similar annoyance iu other pipes elsewhere. The remedy is, of course, to prevent its entry by taking care that the joints are properly filled with cement.

It was intimated that Mr Charles M'Intosh, Inver, had made a valuable donation of plants to the Museum.

Dr Thom, jr., Crieff; Mr Chrystal, Perth Foundry; and Mr Henry Curr, Pitkellony, were proposed as new members.

The following papers were read :—

1. "*Is Polypodium flexile distinct from P. alpestre?*" By Dr Buchanan White, F.L.S.

The Mountain Polypody Fern (*Polypodium alpestre*) is not uncommon on some of the higher mountains of Perthshire (such as Ben Lawers) above an altitude of 2000 feet, and resembles very much in appearance the Lady Fern (*Athyrium filix-fœmina*) for which it was long mistaken. In a barren state (that is when the plant is unprovided with these little collections of seed-cases situated on its under surface, and technically called sori) it is difficult to distinguish the Mountain Polypody from the Lady Fern, but when it is fruitful the difference is easily recognised. The Small Mountain Polypody (*Polypodium flexile*) is not found within the boundaries of the couuty of Perth, but occurs within the district drained by the Tay aud its tributary streams, namely, on Ben Aulder, to the north of Loch Rannoch. It is (or was) also found in Glen Prosen in Forfarshire, and is said to have been met with also in the north of Scotland. It has not been observed in any other country. The author exhibited specimens of both ferns, and read extracts from various handbooks of botany to show the difference of opinion regardiug the question under discussion—namely, whether the two ferns are distinct species, or whether oue is a variety of the other. From this it appeared that all modern authors regard *flexile* as a variety of *alpestre* except Professor Babington, who is also not quite so confident in affirming its distinctness as he once was. The points of distinction betweeu the two forms was then pointed out, from which it appeared that the only constant marks of difference are the narrow base of the pinnules and somewhat narrower frond of *flexile*, in addition to its habit of carrying the fronds nearly parallel with the earth, instead of erect or sub-erect. Generally, however, the piunæ are deflexed, or point down the stem of the frond, instead of pointing straight out or upwards ; and the fruit is more abundant at the base of the frond, and disappears towards the apex.

Moreover, the size of the whole plant is very different, as is its general appearance. Are these points, then, of sufficient importance to make *flexile* be regarded as a distinct species? Most authors have thought that they are not, but then they have considered other ferns (such as the Prickly Shield Ferns—*Polystichum aculeatum*, *lobatum*, and *angulare*, and the Woodsias—*hyperborea* and *ilvensis*), with distinctive characters not a bit more marked than those which separate *alpestre* and *flexile*, entitled to specific or sub-specific rank. Why, then, have they refused it to the two ferns under consideration? It is probably on account of the limited distribution of *flexile*. Had it been found over a wider area of the earth's surface than Scotland, it is possible that many authors would have considered it at least a sub-species of *alpestre*, if not a full species.

(Specimens in illustration of this paper have been deposited in the Society's Herbarium; and the paper is published in full in the *Scottish Naturalist* for 1881).

2. "*On Club-Root,*" *or* "*Finger-and-toe*" *in Turnips.* By Mr A. Stephen Wilson, Aberdeen; communicated by the Secretary.

It was pointed out that it was in connection with the turnip crop that the disease pressed itself on popular as well as on scientific attention. In its mature condition, the fungus *(Plasmodiophora brassicæ)* which gave rise to club root, consisted of globular spores which had a yellowish tint when aggregated in the cells of the club. Iu diameter he found them to be ·0044 mm., or nearly three times the size assigned by Woronin. Many of them were mature iu August and September, but clubbing went on throughout the winter; and the spores, at whatever time ripe, were capable of resisting all meteoric influences, such as drought, rain, and frost, remaining bright aud intact during their period of rest—if indeed it was rest, and not some occult progress—and ready for action, either when a certain time had elapsed or when a certain degree of solar influence had been applied. The spores then, on the application of moisture, rapidly gave rise to variously-shaped amœboid forms, and when a few of these coalesced they aggregated into what seemed a mere plasm. Although he had seen these forms escaping from the spores after a wriggling struggle, they were always more or less blunt at all points, not presenting, as far as he could detect, the whip-like cilium attributed to them by Woronin. He would not dogmatise, as the point had not been sufficiently observed, but he thought it was probable that it was in a condition of plasm that the root hairs or epidermal cells came in contact with this fungus, and absorbed it into the root. A period of rapid growth in the turnip after genial rains, such as characterised this season, was peculiarly favourable to the demands of the fungus. The moisture was sufficient to bring the spores disseminated in the soil into a plasmodic condition, and the rootlets running out in all directions were sure to come across the ambush of some of the burglars — for experiment had shown that earth mixed up with the spores contained in rotten clubs reproduced clubs on the plants grown in it. Clubbing was thus artificial bulbing produced by a fungus of the very simplest type. The plants call up bulbing by natural laws; the parasites call up bulbing by their enchantments. That the cause of clubbing is really a fungus or vegetable parasite under some class cannot be doubted by any one who will look at a few sections of turnip roots; for in these the development is much more easily observed than in the woodier roots of the cabbage. As the loss arising from "finger-and-toe" amounted to many thousands of pounds yearly, was it too much to expect that before long the agriculturists of Great Britain will appoint one or more cryptogamic botanists solely devoted to the fungi of the farm? The one question which the agriculturist had to ask of the cryptogamist was—not what is the nature and what are the properties of a destructive fungus; no, he did not waut knowlege, he wanted money, and he asks—Can you give us a cure? He would ask agriculturists, had they done anything to deserve a cure? Let them take such measures in this matter as the large interests of agriculture demanded; and if cures were not forthcoming, the knowledge would be gained that agriculture must adopt methods under which cures were unnecessary.

(Specimens of club-root, and also microscopic slides of the fungus, were exhibited in illustration of the paper, and presented by the author to the Museum).

Mr PARKER, M.P., in proposing a vote of thanks to the writers of the papers, said he was sorry that he was not able to contribute anything to the discussion on either of the subjects. Both of them were beyond his attainments in science altogether, and he thought that

both were of that character as monographs which perhaps put them beyond the attainments of any who had not devoted their attention to the particular department. He had listened to the papers with great interest, and he had been much gratified in seeing in the proceedings of the Society, as far as he could humbly judge of it, the true principle of scientific research—not speculative general views, such as principles, of which they had almost too many in the present day, propagated in the name of science and without sufficient verification, but the careful study in detail of the works of Nature, the works of God, which alone were the basis on which they could build in the end the highest realisations. In his opinion, it was very instructive to have these ferns compared by Dr Buchanan White, having the specimens before them, as it showed how an undisciplined eye could hardly perceive the differences, yet they were there, and the reward of patient study would make them visible. In Mr Wilson's paper they saw that there was a possible application of agricultural value. As he pointed out, the amount of money at stake to the farmers was great, and it would be well worth their while to provide the means for any competent person to direct his attention to that subject until the cure should be found for the disease. The only other remark which it occurred to him to make was that the conditions under which time can be given to these scientific investigations had been differently conceived at different periods. At the beginning of modern science in this country, which might be dated from Lord Bacon, it would be seen by any one who read Bacon's works that while his imagination placed before him the kind of work—on a large scale—that was necessary, the means he thought of were that of the Royal bounty. He addressed himself to the King, and the idea was that if the King would give his encouragement, and use his influence to obtain a public grant, a great deal might be done. At a later time we get the notion of national encouragement of science, and he (Mr Parker) was afraid that in this country national encouragement of science was uot altogether so liberal as it was in some neighbouring countries. But the essential thing for the progress of science seemed to be that those whose minds were most competent for it should be placed in possession of sufficient leisure to pursue those detailed investigations. One-half of those present were perhaps in a better position so far as regarded leisure than the other, for he thought a great many ladies—although no doubt their duties were very arduous—could devote a considerable portion of their time to the collection and careful scrutiny of specimens; but every man in busy life who had to earn a subsistence, to get the time for this required that either he should be able to bring it to some application of pecuniary value to himself, or else that he should have some kind of endowment or assistance from the public. It might be from the nation or it might be from the local public. He hoped that the local public of Perth had lately been stirred up to manifest greater interest in these researches of science. The Society was providing in memory of Sir Thomas Moncreiffe, who was so very efficient and so highly respected as President, quarters where specimens would be better exhibited, and where a larger number of persons could be accommodated at the meetings with advantage. He hoped they would see with the opening of the new Museum an increase of interest in the subject, and possibly an increase of means placed at the disposal of the Society. Having been very remiss in his attendance as a member of the Society, he was glad to take the opportunity of expressing his interest in its welfare, and in particular in its approaching development when it passed into the new buildings.

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DECEMBER 2nd, 8 P.M.

Dr GEIKIE, F.R.S., President, in the Chair.

NEW MEMBERS.

Dr Thom, jr., Crieff; Mr Henry Curr, Pitkellony; and Mr Chrystal, Perth, were elected members of the Society.

The following papers were read:—

1. "*Natural Rubbish Heaps.*" By James Geikie, LL.D., F.R.S.

In this paper, Dr Geikie gave some account of the various accumulations of rock-debris which are now taking place in this country. He described the appearance presented

by many of the mountain-tops and slopes in our hilly regions. The rocks were often more or less concealed below masses of coarse angular fragments of all shapes and sizes. The hill-tops frequently looked as if they had been subjected to the battering action of some mighty hammer, which had smashed and shattered the rocks to a considerable depth; so that, if we wished to get at the solid and undisturbed parent-mass, we should first have to clear away many feet, and even sometimes many yards, of more or less loose debris. The slopes of such debris-capped mountains were invariably clothed with long sloping taluses of similar fragments, which swept down at a high angle to the valleys, and at the base of these slopes large blocks and isolated masses of rock were of common occurrence. No one who should examine these phenomena could for a moment doubt that they owed their origin to the action of the atmospheric agents. Dr Geikie then described, in a somewhat detailed manner, the mode in which the rocks were broken up by the disrupting force of ice. Water found its way into the crevices of the rocks, and, being frozen there, the joints were gradually widened by the expansion of the ice, again and again repeated. When this action took place on a flattish hill-top the rocks were simply disrupted, and the separate fragments pushed asunder. But upon the verge of precipices, and upon steep slopes, the disrupted fragments were shot downwards, as soon as thaw set in. There were other ways in which rock-debris or natural rubbish-heaps were formed. Strata were often undermined by the action of water, and large masses of rock, deprived of their support, tumbled down in ruins. This could be seen at the base of sea-cliffs, and along the margins of streams and rivers. Then, again, some kinds of rock which were more or less soluble in water were liable, under certain circumstances, to be disjointed and broken up. Limestone, for example, was dissolved by the action of acidulated water working its way downwards through the natural fissures of the rock. In process of time these fissures were widened by this solvent action, and converted into irregular channels and tunnels. This was the origin of most of our limestone caverns. Water continuing to percolate down into such caves gradually loosened the limestone that formed the roof, and now and again large and small fragments of the rock, losing cohesion, fell to the ground. Another cause for the origin of rock-debris was to be found in the peculiar geological structure of certain masses of strata, which were so arranged as to render them liable to sudden and wholesale demolition. When a mountain was built up of a series of porous and non-porous strata, arranged in alternate layers, dipping into the valleys at such a low angle that the edges of the beds were exposed upon the mountain-slopes, such a mountain might at any moment be destroyed. Dr Geikie then referred to several remarkable examples of such catastrophes. In the case of the Rossberg, in Switzerland, the destruction was due to the fact that long-continued rains, soaking down through porous beds above, were arrested by beds of non-porous clay, which, however, became softened to such a degree that the mountain-mass of strata that rested upon them slid forward upon them, and rushed down into the valley. After describing yet other modes in which natural rubbish-heaps were formed, Dr Geikie went on to remark that all the phenomena referred to were more or less exceptional, and that the agent which effected the greatest results was frost. Some of the other agents he had described could only work under certain geological conditions;—others, again, were somewhat limited in their action, and tended to remove the rubbish-heaps which they themselves had accumulated. But the action of frost in a country like ours was, he might say, general. It affected every part of the land, but of course the amount of work it performed was very variable. Its results were most conspicuous in mountain-regions, where frosts were not only more frequent, more intense, and more prolonged, but where the physiographical conditions of the surface lent their aid in the most effective manner. The rock-debris gathered to the greatest thickness upon slopes at the base of a rocky precipice. This was natural, for the steep rocks above, shattered by frost, showered their debris downward. But on flat hill-tops the time must come when the formation of rock-debris would terminate. The rock would only be acted upon to as great a depth as the frost could penetrate. Some account of the frost-riven debris of other countries was then given, more especially of the Swiss Alps, and northern regions of Europe and North America. It was remarkable that many parts of our own country were covered with sheets of debris which had apparently long ago ceased to accumulate, and these sheets occurred not only upon comparatively low ground, but even in mountain-regions. The angular fragments were grown over now with lichen and heath, and even with natural wood, and in every feature betrayed the marks of great antiquity. And not only so, but they occurred in positions to which loose blocks detached from the rocks at higher levels could not possibly have rolled. It was hard enough to account for the presence of such sheets of ancient angular debris in a country like Scotland, but it was more difficult still to explain the presence of similar sheets of angular debris at low levels in the south of England, in Northern France, in Southern Spain, and at many places upon the borders of the Mediterranean. After

giving a description of the so-called "Head" of Devonshire, Cornwall, &c., and the similar accumulation upon the coast of Normandy, Dr Geikie went on to give some account of the clay-with-flints of the Paris Basin and the great consolidated débris - heaps or *breccias* of Gibraltar. By means of sections across the Rock he showed the position of these breccias, and explained how they had been formed at two different periods, separated by a considerable time, during which the Rock of Gibraltar was submerged for some hundreds of feet. After remarking upon the fact that similar breccias occurred in Corsica, Sardinia, Malta, Italy, Cyprus, and other places, he proceeded to explain the mode in which they, the "Head" of Cornwall, the ancient debris-heap of Scotland, and similar formations elsewhere, had been accumulated. The angular fragments had been dislodged from the rock of which they once formed a part by the action of frost. But they could not have rolled to their present position upon the low grounds by the mere impetus acquired by them when they were disrupted from the rocks above. They would naturally come to rest upon the low grounds at the base of the cliffs, unless some other force than the mere impetus of their fall had been urging them forward. We now meet with them at distances of many hundred yards away from the foot of the cliffs and steeper slopes; and to have reached their present positions, they have travelled over a surface-slope not greater in many cases than 5°, or even 3°. The débris speaks not only to the action of hard frost, but of heavy snows. It was the melting of the latter and the saturation of the débris-heaps which caused the rubbish to flow as it were outwards from the base of the cliff, and doubtless this action was still further favoured by the alternate freezing and thawing of the water-soaked masses. It might seem strange to speak of snows and hard frost in the islands and along the borders of the Mediterranean, but the evidence of former colder conditions was not by any means restricted to the ancient débris-heaps or breccias. In a few words, Dr Geikie then sketched the broad results which had been arrived at by glacialists as to the former extent of the European snow-fields and glaciers during the Glacial Period, and he showed that these, taken in connection with the evidence furnished by organic remains, both animal and vegetable, abundantly confirmed the conclusions to which the phenomena of the ancient rubbish-heaps appeared to point. The climate of all Europe had been greatly affected;—not only did an enormous ice-sheet, extending from Scandinavia and burying the British Isles, creep southward over the plains of Northern Germany, but all the mountain-tracts became centres of glaciation. The present glaciers of Switzerland were the degenerate successors of great ice-fields which now meet with their nearest analogues in the Arctic Regions. And many hilly districts in France, Spain, and Eastern and Southern Europe, which were now destitute of glaciers, were formerly the seats of extensive snow-fields and glaciers of no mean size. While in other places, such as the low grounds of Southern England and France, and hilly regions bordering on the Mediterranean, where the conditions were not favourable to the formation of glaciers, considerable snows fell, and hard frost ruptured and shattered the rocks. It was to this period of cold that most of those great accumulations of rock-débris belonged—those natural rubbish-heaps which had now ceased in many places to accumulate. They thus bore strong evidence to the former extent and intensity of ice-action during the Glacial Period.

2. "*The Butterflies of the Perth District.*" By Mr S. H. Ellison.

In offering a few remarks, practical rather than scientific, on the butterflies of the Perth district, my object is, if possible, to create a greater interest among some of the members for the study of insect life, and so increase our number of entomologists. About two centuries ago, naturalists were in the rather unenviable position of being looked upon as lunatics, for we read that the will of Lady Granville,—whose name one of the Fritillaries still bears,—was disputed on a point of insanity, the only evidence produced being her fondness for collecting insects. Happily we live in better times, and the entomologist can pursue his study even without being thought a fit occupant for some asylum. I take this opportunity of impressing upon our members the facilities they enjoy in the prosecution of the study of the various subjects of natural science over those unconnected with this or similar societies. I remember, when I first commenced collecting, I felt the want such a Society as this supplies, namely, some authority to whom I could apply for information as to the habits, localities, and especially the names of insects, for being, as I was, the sole representative of the net in the place where I then resided, I laboured under great difficulties as to the names of specimens. The members of this Society, however, should experience no such drawbacks, for at the monthly meetings they have the opportunity of obtaining any information they may require. I think there is no branch of natural history more interesting or instructive than entomology, for in whatever direction we look the insect world seems replete with wonders. "I cannot," says Swammerdam, "after an attentive examination of the nature and structure of both the least and largest of the great family of Nature, but allow the less an equal,

perhaps a superior, degree of dignity." In looking at the butterflies of this district, our attention is necessarily confined to a very small group in the innumerable host of insect life—a group, however, of the largest for size, or at all events the most beautiful, and one with which all are more or less familiar: and, I think, if anything would create an interest in the insect world, it is the beauty of these butterflies, as we see them in our summer walks, hovering over flowers, or in their rapid flight passing us by on their way, or in the more secure and settled form I show them to-night. But, as Shakespeare, says—

All orators are dumb when beauty pleadeth.

I prefer to leave it to the natural charms of these insects to enlist the attentiou of some of our members. Before giving the list of the butterflies of this neighbourhood, it would perhaps be as well that we just glanced at the very varied transformations through which, like most iusects, they pass before attaining their perfect state. Butterflies and moths beloug to the order *Lepidoptera*, or scale-winged insects,—an order, I may state, which includes over 1900 British species. Some people think that the difference between butterflies and moths is in the colouring of the wings;—others, again, that it is in the time of flight,—the butterflies by day and the moths by night;—but although there are several distinct points of difference, I shall only meution the one which is most easily observed, viz., that the butterfies have knobs at the ends of their antennæ or feelers, hence they are frequently called *Rhopalocera;* while those of the moths, or *Heterocera*, are straight, and usually tapering, except in some of the hawks and burnets, but eveu in these it is an easy matter to perceive the difference. They display remarkable instinct in depositing their eggs, selecting with unerriug certainty the food-plant best fitted for the support of their offspring. The eggs vary very much in size and color, but it is only by the aid of the microscope that we are enabled to see the beautiful forms they assume. After emerging from the egg, we find it iu its second or larval state. During this period of its existence its whole business seems to be to eat, which it usually does most voraciously, frequently chauging its skin, to allow for its rapid iucrease in size. After remaining in this form for a certain time, which varies greatly in different species, it passes to its third or pupa state, in which condition it neither eats nor moves. In the butterflies the forms of pupæ are very similar. The one I have here I found on a window a day or two ago, and is *Pieris rapæ*, or the Small Garden White. Close beside it I also found some cocoons of the parasite which proves so deadly to this species. If you look at it closely, you will observe the formation of the wings quite distinctly; and a few days before the appearance of the butterfly, were it a bright-coloured one, you would perceive the colour and markings of the enclosed insect. Some butterflies, when going into the pupa state, suspend themselves head downwards; while others, of which this is one, keep their heads erect. Then comes the last stage—the imago, or perfect insect. I think these wonderful changes cannot but be regarded with the highest interest when we think that from the worm-like creature we saw slowly crawling along, and devouring everything around it so greedily, after a period of deathlike repose, should emerge this beautiful insect, adorned with wings of such brilliant colours, and taking for its food the most delicate fluids the vegetable kingdom can supply. Haviug briefly looked at the earlier life of a butterfly, let us now come to the list of those frequenting the district of Perth. I shall only mention those I have myself found, and have reason to believe there are two or three other species I have not yet had the pleasure of meeting with. Out of the 67 in the British List, I have caught 20, and have brought specimens of each with me. The first family we find represented is the *Pieridæ*, of which we have in the genus *Pieris* three species. Both sexes of each are shown, viz., P. brassicæ, Large Gardeu White, and P. rapæ, Small do. Found abundantly in gardens, &c. Larva feeding on cabbages. P. napi, Green-Veined White. Found in woods and fields. Larva feed on rape, &c. In the genus *Anthocharis*, we have the only representative, A. Cardamines, Orange Tip. Both sexes and under side of male shown. Glen Farg is the only locality where I have taken this, and even there it seems very scarce. Found in May and June. The next family is the *Vanessidæ*. In the genus *Argynnis* we have three species. A. Aglaia, Dark Green Fritillary. Both sexes and uuder side exhibited. Got during July and Aug. at Glen Farg, Kinnoull, and several other localities. Larva feeds on Dog Violet; A. Euphrosyne, Pearl-Bordered Fritillary, and A. Selene, Small do. Upper and under sides of each shown. Both found duriug May and June at Glenfarg and other localities around here—the former very plentifully, the latter rather scarcely. In the genus *Vanessa*, we have also three species. V. Urticæ, Small Tortoiseshell, or, as I find it commonly called here, "The Goldy." Common everywhere. Larva feeds on nettles. V. Atalanta, Red Admiral. Upper and under side shown. Some years this beautiful butterfly is pretty common, but this year (1880) it has been very scarce so far as I have observed. Larva feeds on nettles. The perfect insect is met with during August and September, although, as is the case with most of the Vanessæ, hybernated specimens are occasionally met with during the spring. V. Cardui,

The Painted Lady. Upper and under side shown. Found at Glen Farg. I have also seen this on Callerfountain Hill and near Seggieden. Last year (1879) it was very plentiful around here, as, indeed, it was over a great part of Europe. This year it has been conspicuous by its absence. In the family *Satyridæ*, and genus *Satyrus*, we have four species. S. Ægeria, Wood Argus. Found in July and Aug. It seems very scarce, and the only place where I have taken it is Kinnoull. S. Semele, Grayling. Male and female shown. Very common on Kinnoull in May and September. It flies up the cliff, and seems rather to like windy days. S. Janira, Meadow Brown. Male and female shown. One of the least attractive - looking of all our butterflies, and is, I think, even commoner than the whites. Found from June to August. Larva feeds on grasses. S. Hyperanthus, the Ringlet. Upper and under side shewn. Like the last, this is common everywhere. We can boast the two members of the Genus *Cœnonympha*. Both sexes of each shown. C. Davus, Marsh Ringlet. Found on Methven Moss, and at one of this year's excursions we found it at Sma' Glen. Larva feeds on the cotton grass, &c. C. Pamphilus. Small Heath. Common everywhere. Larva feed on grasses. In the family *Lycœnidœ*, genus *Thecla*, I have only found one species. T. Rubi, Green Hairstreak. Upper and under side shown. Not plentiful. I have taken it on Kinnoull in May. As it is double-brooded, it will likely be found in September also, but I have not seen it. Larva feeds ou bramble, broom, &c. Genus *Polyommatus*.—P. Phlæas, Small Copper. This pretty little fly is common from May to September. Larva feeds on sorrel. In the genus *Lycœna* we have two species. L. Artaxerxes is found on Kinnoull, Callerfountain, Glen Farg, &c. L. Alexis, Common Blue. Male and female shewn. Found plentifully on Kinnoull, and almost everywhere. Larva feeds on clover, grasses, &c. This closes my list, but it will perhaps be as well to add that I believe *Melitœa Artemis*, The Greasy Fritillary; *Thecla Quercus*, Purple Hairstreak; *Lycœna Alsus*, Little Blue, are still to be obtained around Perth.

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THURSDAY, January 6, 2 P.M.

DR GEIKIE, F.R.S., President, in the Chair.

The Secretary reported that the following books had been received:—Journal of Royal Microscopical Society, vol. viii.; Revue Bryologique, 1875-1879; Entomologisk Tidskrift, Bd.I., 1880. There had been bought for the library Dr Braithwaite's British Moss Flora.

Mr John Campbell, optician, Perth, was proposed as a member.

The following papers were read:—

1. "*A Naturalist's Experiences in Amazonia.*" By Prof. J. W. H. Trail, M.A., M.D., F.L.S.

The author gave, from his personal experiences, an account of the obstacles and annoyances that must be eucountered by naturalists in that country, in so far as these are due to animals, more especially to insects. The insects and ticks that attack man directly were noticed, and their habits and modes of life were described shortly. The most troublesome species are found among the diptera, or two-winged flies. Few localities are free from some species or other of flies, though some are far more infested than others. Those rivers with muddy water seem most to favour the increase of these insects. The residents on the Amazon, and on several of its southern tributaries along the middle of its course (*e.g.*, the Madeira, the Purus, and the Juruà), are much afflicted in this way, more especially at certain seasons of the year. Among the worst pests are various species of mosquitos, piums, maruim, or sandflies, and of cowflies, of which last the worst are the motūcas, and a nearly-allied fly about the size of a blue bottle, which possesses a proboscis about half-an-inch long, and can pierce the skin even through clothes. Mosquitoes fly only after nightfall, except in the shady forests or in dark houses. Piums fly only by day, and can bite only bare skin. Maruims are most troublesome about dawn aud at sunset, and from their very small size can creep through the meshes of mosquito-curtains, hence they are difficult to keep off. Motūcas fly only by day, aud bite ouly bare skin; hence their attacks, like those of piums, can best be warded off by keeping face, neck, hands, and feet well covered. In the poorer class of houses, especially if they have been occupied for some time, and have then been allowed to stand empty for a month or two, fleas are apt to swarm, and to attack a visitor fiercely. The worst pest among them is the chigoe (*Pulex penetrans*), loug ago noted for the habit of the female in penetrating under the skin of the toes and there giving rise to sores, if not speedily removed. Of ticks (*Ixodes*) called *carapātos*, there are large ones, much like dog-ticks, and small, about the size of a pin's head. They iufest the paths through jungle near villages, and also the weeds that over-run the streets. Climbing up the shrubs,

they rest on the leaves, and, holding on with only the last pair of legs, they stretch out the other three pairs ready to grasp any passer-by. On reaching skin they push in their beak and first pair of legs, and they are most difficult to remove entire. The head and legs are apt to be broken off and to remain, and frequently cause troublesome sores. A minute red mite, known in Amazonia by the name mocuim, is excessively abundant in the same localities as the ticks. It makes its presence known by causing small red swellings, on the top of which it may be discovered on close examination. Speedy relief is obtained by washing the swellings with spirits. The mite is nearly related to the harvest-mite *(Leptus autumnalis)* that is occasionally troublesome even in Scotland.

2. "*The Life and Labours of a Scottish Botanist—George Don, of Forfar.*" By Mr John Knox, Forfar.

Don, it appeared, was born after the middle of last century, and though of humble grade in life was so inspired with a love for Nature that neither reduced circumstances nor the hardship and toil which the pursuit of his studies over hill and dale, and by loch and riverside, inferred, could weaken the passion of his life. Of the vegetable and animal kingdom his knowledge was exact and extensive, and more than one of his discoveries were considered of value in the domain of botanic knowledge. After giving a short sketch of Don's life previous to his settling down in Forfar, Mr Knox gave a description of the famous Forfar Botanic Gardens, and afterwards spoke of Don's admission as a member of the Forfar Library, and of Forfar at the commencement of the century. Several reminiscences of the botanist's rambles in search of flowers were given, and Mr Knox noticed his letter to Patrick Neill as to the decay of the Scotch fir, and his account of the native plants in the county of Forlar, and the animals to be found there, published in 1813. Don died at a comparatively early age, and was buried in Forfar churchyard, but over his tomb there was no stone. Mr Knox fittingly closed his paper by asking whether nothing could be done by the votaries of his favourite science to mark the spot where he lies.

[This paper is published in full in *The Scottish Naturalist* for 1881.]

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THURSDAY, February 7, 8 P.M.

DR GEIKIE, F.R.S., President, in the Chair.

PROPOSED MICROSCOPICAL BRANCH.

The Secretary read a letter from Mr Campbell, optician, requesting the Society to consider the advisability of forming a microscopical branch, and stated that the matter was under consideration.

NOMINATION OF OFFICE-BEARERS.

The following gentlemen were nominated as office-bearers for the session 1881–82:—*President*, Dr Geikie, F.R.S.; *Vice-Presidents*, Rev. Dr Milroy, and Messrs Horace Skeete, A. B. Sandeman of Huntingtowerfield, and Robert Pullar, F.R.S.E.; *Secretary*, Mr John Young, C.E., Tay Street; *Treasurer*, Mr John Macgregor, Post Office; *Curator*, Col. Drummond Hay, C.M.Z.S., of Seggieden; *Editor*, Dr Buchanan White, F.L.S.; *Librarian*, Mr George Young; *Councillors*, Messrs Andrew Coates, Magnus Jackson, and S. H. Ellison.

NEW MEMBERS.

Mr Campbell, optician, High Street, was unanimously elected, and the following gentlemen nominated as new members:—Messrs Patrick Geddes, Edinburgh; William Ellison, Robert Williamson, John Sydney Farquharson, and William Hall, Perth.

The SECRETARY intimated that the following donation had been received:—"The Cobham Journals," by Caroline Molesworth and E. A. Ormerod, from Miss Ormerod. Five volumes of "Sitzungberichte der K. K. Zoologisch-Botanischen Gesellschaft in Wien," and the "Revue Bryologique," had been received in exchange for the "Scottish Naturalist;" and "Illustrations of British Fungi" had been purchased.

THE PERTHSHIRE NATURAL HISTORY MUSEUM.

DR GEIKIE, President, then addressed the meeting as follows:—Before we proceed to the reading of the papers set down for this evening, I have to ask your attention for a little, while I endeavour to correct certain misrepresentations, which are being industriously circulated with a view to prejudice the good folks of this town and county against our Museum scheme. I refer to an anonymous article which appeared a short time ago in a local newspaper, and which, as I understand, has been reprinted and widely distributed. The statements in that article have, I notice, already been called in question and refuted in the same newspaper, by a correspondent (who signs himself "Truth") with whose remarks I quite agree. "Truth" states, what is evident enough, that the writer of the article had two objects in view; namely, to extol and glorify the Literary and Antiquarian Society, and to decry and depreciate the Perthshire Society

of Natural Science, and its efforts to raise and complete a Natural History Museum. Now, I can only say that had the writer of the article confined himself to the first object, we should have had no cause to take any notice of his effusion. So far as the Council of this Society is concerned, he is welcome to puff and advertise his friends' scheme to his heart's content;—he may exalt their horn and blow their trumpet as long and as loudly as he feels inclined. Probably he felt that there was need to say something for a Society which seems so little able to say anything for itself. But in his laudable desire to make as much of the Literary and Antiquarian Society as he could, he has been betrayed into certain inaccuracies and misrepresentations which, considering the publicity they have acquired at the hands of those who act for that Society, can hardly be allowed to pass unchallenged. The strenuous exertions made some time ago to bring about common action between the Literary and Antiquarian Society on the one hand, and the Perthshire Society of Natural Science on the other, must be in the recollection of every member of this Society, and can hardly have been forgotten by the general public. These exertions, as we all know, came to nought,—the two Societies could not agree,—a result which we have always regretted, but for which our Society cannot take any blame. Our final proposal to the Literary and Antiquarian Society, I may remind you, was that the two Societies should agree to build one common Museum,—the ground-flat and principal portion of which, containing a "General Collection," should be under the exclusive charge of the Literary and Antiquarian Society; while we were content to have the galleries assigned to us, for the purposes of a "Local Collection" illustrative of the Natural History of Perthshire. This was the main proposition, and the others were equally favourable to the Literary and Antiquarian Society. No concession on our part, however, would please our friends. Nothing less would satisfy them than that we should perform the "happy despatch" upon ourselves as a Society, and thereafter acquire the privilege of becoming paying members of the Literary and Antiquarian Society. And this is what the anonymous writer in his article terms dealing "fairly, generously, and kindly" with us! Now, we naturally had no desire to sink our individuality, and perform that "happy despatch" so kindly desiderated by our friends, and we did not think that the honour of becoming members of the Literary and Antiquarian Society was so overwhelming as to be a sufficient recompense and compensation for thus ceasing to exist. In addition to these "fair, generous, and kindly" conditions suggested by the Literary and Antiquarian Society, as the price we should have to pay for its co-operation, there was another to which we took decided objection,—and that was the proposal that we should forego our scheme of building a new Museum in Tay Street, and assist them to increase their Museum accommodation by extending their present buildings in George Street. To this we objected, and gave many cogent reasons for so doing. Nevertheless, to show that we were by no means obstinate in the course which we saw fit to take, but were anxious, at almost any hazard, to bring about the co-operation of the two Societies, we readily agreed that the rival schemes should be submitted to the public, and were willing to abide by their decision. To this the Literary and Antiquarian Society also agreed; and subsequently a public meeting, consisting of representatives from every section of the community, was convened in the Guild-Hall, under the presidency of the Lord-Provost. Now, at this meeting it was unanimously agreed that there was clamant need for greater Museum accommodation in Perth, and it was remitted to a Committee to consider and report upon the rival schemes. The result you all know: the Committee reported decidedly in favour of the scheme which this Society advocated, and which Sir Thomas Moncreiffe was the first to propose. I think we might well complain that the Literary and Antiquarian Society, after having sought judgment from the public and had that judgment given, should not have thought fit to abide by the decision, and co-operate with us. Not only has it not done so, but the action it has taken is such that it would almost appear as if it had been designed to thwart us in our endeavour to realize the scheme which our fellow-citizens have already approved. The writer, to whose article I have referred, states that "very considerable confusion seems to exist in the public mind with regard to the two Museum schemes now before them." But the public has not so short a memory as he seems to think. It is perfectly well-known that the new building in Tay Street is the realization of the scheme suggested by Sir Thomas Moncreiffe, advocated by our Society, and approved of by the public. And it is equally well-known that the proposal to increase the Museum accommodation of the Literary and Antiquarian Society, by extending the ugly and awkward building known as Marshall's Monument, has been emphatically condemned by the public, and is even disapproved of by *many* members of the Literary and Antiquarian Society itself. We have, therefore, as we think, good cause to complain of the action taken by that Society—an action which I am certain it will soon regret, if it

does not already do so. But although the co-operation of our Literary and Antiquarian friends would have smoothed our way, and also tended greatly to their own advantage, we have brought no complaint against them; on the contrary, we wish them all success in the course they have thought best to follow, however much we may doubt its wisdom. Fortunately, we are in a fair way to accomplish without their aid the end we have all along had in view, namely, the establishment of a good educational museum. I only hope that, should our non-co-operating friends meet with sufficient encouragement from the public in their zealous endeavour to extend their premises, they will not forget to thank us for having stirred them up to such unwonted exertion. For before Sir Thomas Moncreiffe had published his views on the subject of museum-extension, and our Society had begun to move in the matter, the necessity for more accommodation does not seem to have occupied their attention. We are told, it is true, that the Museum-scheme of the Literary and Antiquarian Society "is nothing more than that of the late Mr Craigie and his able coadjutors, of about twenty years ago, adapted to the requirements of the present day." Of what happened in Perth twenty years ago I cannot speak, but I know that when I came to reside here, some five or six years ago, there was no talk whatever about Museum-extension. Sir Thomas Moncreiffe was the first who spoke to me on the subject, and he very shortly afterwards set forth his ideas in a presidential address to this Society; and I have since been assured by others long resident in Perth that the subject had never been mooted in public until Sir Thomas broke silence. Our anonymous assailant goes on to make certain comparisons between the Literary and Antiquarian Society and the Perthshire Society of Natural Science, with the view, of course, of showing how greatly the former outstrips the latter. We are told, in the first place, that the Literary and Antiquarian Society is nearly a century old. That being the case, one may be excused for asking what the Society has done? Before this recent stir about a new Museum, it would seem to have been as lifeless, dry, and dusty as its own specimens. I must say that I had never heard of it before I came here, and I only discovered that there was such a Society after a visit paid to the Museum in George Street. Of the natural history collection in that Museum I would rather not speak, as anything I should say would hardly be complimentary. I would only remark that, considering the lengthened period it has been under the care of a learned Society, much more might have been expected in the matter of selection, arrangement, and nomenclature of specimens. It is stated, however, that "large and valuable collections," the property of the Society, are stowed away in out-of-the-way places, for want of space to exhibit them, and that, when these are displayed, Perth will be provided with a "Provincial Museum in full development." This, I would observe in passing, is no excuse for the dilapidated and neglected state of the collection which is at present on view in Marshall's Monument. That collection might be correctly described as a confused heap of valuable and worthless odds and ends, which, even with the addition of the seedy-looking cast-off specimens from the Edinburgh Museum—those hairless, earless, and legless "objects," which were exhibited at "the memorable conversazione in January, 1878,"—would not form a creditable "General Collection;" and would certainly be of little or no importance in an educational point of view. And I feel quite confident that if "the leading men of science at home and abroad" were to visit the collection for which their "active support" is stated to have been promised, they would agree with every word I have said about it. I would much rather have avoided making these remarks: the recent ungenerous attack upon us, however, has left me no alternative, as President of this Society, but to speak out. And now, in concluding, I shall give our incautious assailant some information about this Society which may be useful to him on another occasion. In the first place, I have to inform him that the Perthshire Society of Natural Science was not "started" by Dr Buchanan White, but by a few working naturalists, who, seeing no signs of vitality in the Literary and Antiquarian Society, and tired of waiting for the dry bones to move, called a meeting to consider the propriety of forming a Natural History Society. Amongst others to whom notice was sent was Dr Buchanan White, who, when the Society was formed, was elected President. In the second place, I may tell him that it is not true that this Society has very few specimens. It has several thousand valuable specimens illustrative of the fauna and flora of Perthshire, and forming more than a nucleus of what it is confidently expected will be, in due time, one of the most instructive Provincial Museums in the country. That the specimens are not more numerous arises, simply from the absence, hitherto, of any place to contain them. I may add that we have every assurance of assistance from local naturalists scattered up and down the county, who will gladly send us specimens, as soon as our cases are ready to receive them. Although our Society is young, it has yet, I venture to say, done more in the comparatively few years of its existence than the older Society has been able to accomplish since it ceased working "nearly a century" ago. I had heard of the Perthshire Society

of Natural Science a number of years before I came into contact with any of its members. Its journal (*The Scottish Naturalist*) has long been well known, not only at home but among working naturalists abroad. Several noted Scientific Societies, both at home and abroad, at their own suggestion, exchange their "Transactions" for the journal referred to. And, I may mention the fact, which may not be generally known, that there seem to be only three towns in Scotland which appear in the "Exchange Lists" of several British and foreign scientific societies—namely, Edinburgh and Glasgow, with their numerous scientific bodies, and Perth, which is represented by the Perthshire Society of Natural Science. Our Society, therefore, occupies an honourable position, and has afforded proof of having performed good work up to the present time, which is the best earnest it can give of its ability and desire to do more in the future. It is with every confidence, therefore, in the soundness of our Museum scheme, that we have appealed for aid to the public, and the response which we have already received has been extremely gratifying. To the ladies who have so willingly agreed to help us we return our most sincere and grateful thanks; and I have not the smallest doubt that ere long, with their kindly assistance, we shall be able to announce that the much-cherished scheme of our late President, Sir Thomas Moncreiffe, has been completely realised.

Mr Andrew Coates said the statement which had just been made by Dr Geikie was a most able one, shewing clearly the position of the Society; and it was an admirable reply to the attack that had been made upon them. He thought it was very desirable that the Society should get the paper printed and circulated as widely as possible among the public, so that they might know the exact position of the two Societies, aud he moved accordingly. He also moved that a hearty vote of thanks be awarded Dr Geikie for having made the statement.

Mr John Thomas seconded both motions of Mr Coates, which met with the entire approval of the meeting.

The following paper was read :—

"*The Pearl Mussel (Unio margaritiferus) of the Tay.*"
By Mr Henry Coates.

During our last session, we were favoured with a paper by Dr Buchanan White on "Cuttlefish and their Allies." These, as doubtless he pointed out, form the most important representatives of the first of the five great classes into which the sub-kingdom mollusca is divided, namely, the *Cephalopoda*, or "head-footed" molluscs. The fresh-water pearl mussel, which forms the subject of the present paper, is a well-marked type of another of these five classes, namely, the *Lamellibranchiata*, or "plate-gilled" molluscs, and this is in part my reason for bringing it under the cousideration of the Society to-night. Another reason is that it occupies an important position in our local fauna, as the Tay has for centuries been the chief centre of the pearl fishery in this country. Before entering on a description of the mussel, it may be well to mention the characteristics which it possesses in common with the cuttlefish, and which entitle each to a place in the same sub-kingdom. Of these the most important are the following :—Both possess a soft body with a complete digestive system isolated from the general body cavity, and a nervous sytem with three nerve centres, or *ganglia*. Both, moreover, possess a shell, though with this difference, that while that of the mussel is external and forms a covering for the body, that of the cuttlefish is internal, and merely acts as a support. Leaving these points of resemblance—which, it will be observed, are very broad, and thus indicate how comprehensive the sub-kingdom is—we have now to consider the structure of the creature before us in greater detail, and shall begin with the outer covering or shell. In examining the shell three things are particularly to be observed ;—first, that it consists of two separate pieces or "valves;" second, that these two valves are exactly similar to one another in form; and, third, that each valve is unsymmetrical—that is, uot equal-sided. The shell of the mussel is, therefore, said to be "bivalve," "equivalve," and "inequilateral,"—three peculiarities which are common to the shells of all molluscs belonging to this class. The two valves, being situated one on either side of the creature, are called "right" and "left," and are thus distinguished from those of another class of bivalve molluscs, which are more properly described as "upper" and "lower." When the shell is held with the "hinge" (or line of juncture between the two valves) uppermost, and the rounded extremity pointing forwards, the valve on the right-hand side of the observer is the right valve, and that on the left-hand side the left. The rounded end of the shell is the front, or "anterior" extremity, and the more pointed the "posterior." The shell of the mussel is made up of three distinct layers, differing from each other in material. Lining the interior is a layer of mother-of-pearl or *nacre*, which consists of nearly pure carbonate of lime, arranged in extremely delicate plates. These plates, by interrupting the rays of light, give to this lining its irridescence which we all admire so much. In a fresh specimen, the play of colour through every shade of crimson, green, and

gold is exceedingly beautiful. The pearls, of which we shall have more to say presently, consist of identically the same material as this layer. Covering the mother-of-pearl is a thick coating of brown horny material called the *epidermis;* while over that is a delicate skin, termed the *periostracum.* These two last layers not only protect the limey part of the shell from being worn away by friction, but protect it from the decomposing action of the carbonic acid and other gases contained in the water. An examination of the inner surface of the shell gives us a clue to the mechanism by which the animal is enabled to open and close it. Along the hinge-line of each valve will be observed a groove or channel. When the valves are brought together these form a small chamber, which is filled with an exceedingly tough and elastic ligament. The tendency of this ligament is to force the valves asunder, so that the natural position of the shell is to be about half-open, and in this position the creature generally keeps it when at ease. On being alarmed, it instantly closes its shell, which it does by contracting two powerful muscles, one of which extends between the two valves at either extremity of the shell. These are termed respectively the anterior and posterior adductor muscles, and the four scars which mark the points at which they are attached to the shell may be distinctly seen on examining a fresh specimen. So long as the shell is kept closed, the ligament is being compressed; so that whenever the adductor muscles are relaxed, the shell springs open in consequence of the elasticity of the ligament. Judging from the analogy of such creatures as crabs and lobsters, and from the fact that so many empty shells are thrown up by the water, many persons suppose that the mussel and other molluscs cast off their shells periodically in order to form larger ones. This, however, is impossible, as the mussel, unlike the lobster, is inseparably and organically attached to its shell. If we take a mussel and look at the outside of the shell, we shall see that each valve is marked with a series of lines concentric with the outline of the shell. Each of these "lines of growth," as they are called, represents the outline of the shell at a certain stage of its growth, and thus we find that the shell increases in size by being added to at its outer margin. If we now open the mussel, we shall find that the creature is completely enveloped in a thin membrane, consisting of two halves or "lobes," one of which lines the interior of each valve of the shell, and corresponds to it in shape. We shall also observe that this membrane—or "mantle," as it is called—is considerably thickened round its margin, and that there is a scar on the inner surface of each valve corresponding to, and caused by, this thickened margin. It is by means of this mantle that the mussel builds up its shell—a process which it is continually, though very slowly, carrying on. The manner in which it secretes lime, horny material, &c., from the water, and constructs its shell out of these by means of its mantle, is one of the many secrets which Man has tried in vain to wrest from Nature. The fact of each mollusc constructing its shell after the same pattern is another of Nature's mysteries which we can admire and wonder at, but cannot explain. We now turn from the shell to consider the creature which it contains, and which, if less attractive to the general observer, is equally interesting to the naturalist. If we take a specimen from the river, and lay open the shell by passing a sharp knife between the valves in order to sever the adductor muscles, we shall see a tongue-like process lying in the centre of the fleshy mass displayed. This is termed the "foot," and although it scarcely corresponds with what people generally conceive a foot to be, yet the term will be found to be appropriate enough if we watch a live mussel, and observe it gradually pushing its way from stone to stone, or burying itself in the mud by the aid of this organ. At the base of the foot, and in the vicinity of the hinge-line of the shell, lie the digestive system and the heart, which are intimately associated with one another. The digestive track commences with a mouth which is situated near the front adductor muscle, and which is provided with no teeth, but is guarded by four soft leaf-like processes, which perform the function of the lips of higher organisms. The intestine passes through the ventricle of the heart. The heart consists of a ventricle and two auricles, the whole being enclosed in a delicate covering or pericardium. The purified blood—for mussels, and oysters too, possess blood—is a clear colourless fluid, and is received from the gills into the auricles, from whence it is passed into the ventricle, which, by its pulsations, propels it through the blood-vessels. The gills are four in number,—two occurring on either side of the foot, and lining the lobes of the mantle in the form of delicate plate-like membranes, which, from their peculiar form, give the name of *Lamellibranchiata*, or "plate-gilled," to this class of molluscs. The inner surfaces of these gills, when examined under the microscope, are seen to be covered with exceedingly delicate filaments, termed "cilia," which are constantly and rapidly vibrating backwards and forwards. The object of these is to create a current of water through the gill-chamber, which brings with it a supply of fresh oxygen to purify the blood. On the surface of each gill is a net-work of minute blood-vessels, and by this means a large quantity of the blood is exposed at one time to the influence of the oxygen. The nervous

system of the mussel consists of three nerve masses or centres, or, more correctly, of three pairs of nerve masses, connected with one another by a system of nerve-cords. The first of these centres of "ganglia" is situated near the mouth, and is probably chiefly concerned in controlling the digestive organs; the second lies in the foot; and the third is associated with the adductor muscles. The only organ of sense which has been discovered is one of hearing;—an ear it can scarcely be called, as it is merely a little sack containing fluid, and calcareous particles termed "otoliths."

The young mussels are developed from eggs, of which some 200,000 are computed to be produced by each individual in a year, though the number is sometimes very much greater. The spawn is kept within the shell of the parent mussel until the eggs are hatched. The young or "larval" mussel is so unlike a mature specimen, that, did we not know something of its history, it would be impossible to recognise it as the same creature. The shell is thin and globular, each valve being triangular, and terminating in a sharp hook; the mouth is very wide; the foot small; and the gills scarcely developed. The first few days of its free existence it spends in a very lively manner, swimming about through the water by rapidly opening and closing the valves of its shell, or attaching itself to some floating object, sometimes even fixing itself to the tail of an unlucky fish by means of the sharp hooks with which its shell is provided. This free-swimming condition in which the mussel spends the early part of its existence is an admirable provision for the dissemination of the young molluscs, which would otherwise be deposited in such large numbers in one place that they would not be able to obtain sufficient food; and in the retention of the spawn within the shell of the parent we see a provision for protecting it from being preyed upon by fish. At length the young mussel enters on a more sober and settled existence, spending the rest of its days among the stones or mud of the bed of the river. It generally lies with the rounded end of the shell imbedded in the sand or mud, and the valves partly open,—the opening facing down the stream, so that the back of the shell acts as a breakwater to divide the current. The cilia of the gills create a constant flow of water through the shell, which not only renews the blood, but brings a supply of food to the mouth. The food consists of minute organisms, such as Infusoria, Diatoms, &c., besides particles of vegetable matter, as more solid material could not be assimilated without a masticatory apparatus such as we find in the higher molluscs. The mussel is very susceptible to external influences, instantly closing its shell when disturbed; and, although no organ of sight has yet been discovered, it is found to be considerably affected by light, keeping its shell open on a bright sunny day, but closing it when the sky is overcast. At times it manages to crawl to a considerable distance by means of its foot, and is observed to be most active in spring, just after the spawning season.

As regards habitat, the pearl mussel is generally found in swift-flowing rivers, and in the streams and lakes of mountainous districts. This explains its distribution in Britain, where it occurs in Devon, Cornwall, North and South Wales, the mountainous districts of Cumberland, the rivers flowing from the Highlands of Scotland, and those of the north and south of Ireland. In Scotland I have collected specimens from the Tay, the Tummel, the Garry, the Earn, the Forth, the Teith, the Allan, the Doon, and Loch Tummel. On the Continent it ranges through all the hilly regions, from Lapland to the Alps and Pyrenees, which form its southern limit. It is particularly abundant in Norway and Sweden, and Prof. Forbes believes the Scandinavian Peninsula to have been the centre from which it has spread through Europe. The scientific name of the present species, *Unio margaritiferus*, was given to it by Linnè, in reference to its pearl-bearing propensity. The family to which it belongs is the *Unionidae*, the family of the fresh-water mussels. The chief home of the family is in the rivers of North America,—the United States, alone yielding over 100 species,—while in Europe the number both of species and of individuals is comparatively small. The family embraces in all 420 species, and its range is very wide, extending over North and South America, Europe, Asia, Africa, and Australia. In a fossil state it is represented in the Wealden of Europe and India. Besides *Unio margaritiferus*, three species belonging to the same family occur in Britain, namely, *U. tumidus*, Philippsson, and *U. pictorum* Linnè, which are confined to the streams and canals of Southern and Central England; and *Anodonta cygnea* Linnè, which extends into Scotland.

I am not aware that the pearl mussel has ever been used as an article of food in this country, but in the South of France it is eaten in considerable quantities. Regarding its qualities as an article of diet, I can say nothing from personal experience!

The manner in which pearls are formed long remained a mystery, and many absurd notions prevailed regarding it. An article in the *Quarterly Review* for 1815, describing one of these popular fallacies, says:—"The Arabs, with whom the pearl was an article of great commerce, entertained a notion, which they had from the Brahmins, that when it rained the

animal rose to the surface to catch the drops, which it turned into pearls." In the *Philosophical Transactions* for 1674 there is an article, by a naturalist named Cristophorus Sardius, describing the pearls as the eggs of the mussel, which is a more plausible theory than the last, though I fear he would have to wait some time before such eggs came to maturity! A more poetical idea was that the mussel took the dew-drops into its shell in the early morning, and by some magical process converted them into pearls. Thus Camden, an early naturalist, says:—"They (*i.e.*, the mussels), by a kind of irregular motion, take in the dew and produce pearls." The formation of pearls is now known to be purely accidental. When a particle of sand or any other foreign body gets under the mantle, the mussel, irritated by the friction produced, but unable to rid itself of the cause of annoyance, renders it as inoffensive as possible by covering it with a smooth coating of mother-of-pearl, similar to that with which the shell is lined. That this is a reasonable explanation has frequently been proved by inserting a hard particle under the mantle, when, after a time, a pearl is generally formed. This circumstance has long been known to the Chinese, who introduce lead pellets and mother-of-pearl beads within the shells of mussels, and keep the latter alive in ponds until the pearls are formed. Linnè tried a similar experiment by boring a small hole in the shell, and thus introducing particles of sand under the mantle, and it is said that it was chiefly owing to this supposed discovery of the method of procuring artificial pearls that he was ennobled, although we now know that the discovery was originally made long before his time. Mr James G. Bertram, in a book entitled *The Harvest of the Sea*, says that pearl-fishers always select deformed or wrinkled shells as being more likely to contain pearls than those of a smooth surface. The explanation of this probably is, that the efforts made by the mussel to rid itself of its enemy prevent it from constructing its shell as regularly as it would have done had there been no cause of disturbance.

Britain, and in particular Scotland, has long been noted for the production of fresh-water pearls. The earliest mention we have of them is in a passage of Pliny, in which he describes a breast-plate covered with British pearls, which was brought to Rome by Julius Cæsar, and deposited by him in the Temple of Venus Genetrix. Some doubt exists as to whether these pearls were derived from *Unio margaritiferus* or from *Mytilus edulis*, the common mussel of our sea-shores, but the balance of opinion appears to be in favour of the former. It has been affirmed that the fame of the British pearls was one of the causes of Cæsar's expedition to this country. The following interesting historical allusion to a pearl in the Crown of Scotland is taken from a book called *Edinburgh, Old and New*:—"The great pearl in the apex of the Crown is alleged to be the same which in 1620 was found in the burn of Kellie, in Aberdeenshire, and was so large and beautiful that it was esteemed the best that had at any time been found in Scotland." Sir Thomas Menzies, Provost of Aberdeen, obtaining this precious jewel, presented it to James VI., who in requital "gave him twelve or fourteen cauldron of victuals about Dunfermline, and the custom of certain merchant goods during his life." This pearl had undoubtedly been obtained from *Unio margaritferus.*

In recent times, the Tay, from Perth upwards, has been the principal seat of the pearl-fishery in Britain, but owing to the large number of mussels which have been destroyed by the fishers the number of pearls obtained has gradually diminished, so that the industry has now ceased to be one of any considerable importance. Still, you must all be familiar with the scene presented by the river during a drought in summer, when scores of children may be seen wading about in the shallow water searching for the coveted treasures. I have already mentioned that the mussels lie in the bed of the stream with the valves slightly apart. The fishers take advantage of this, when gathering the shells, to thrust a thin rod between the open valves, when the latter instantly close, and thus the mussel becomes the unconscious means of its own capture. Pearl-fishing cannot now be a very lucrative employment, as it is calculated that only about one in a hundred of the shells opened contain a pearl, while not more than one in a hundred of the pearls found is sufficiently perfect in form and pure in colour to be of use for ornamental purposes. The value of such pearls is from £1 to £2, though occasionally one is found which is worth as much as £10. The value of pearls sent from the Tay to London between the years 1761 and 1764 amounted to £10,000, which will serve to indicate how greatly the industry has fallen off in value since that time. I shall conclude by expressing the hope that it may be long indeed ere the ravages made upon the pearl mussel succeed in blotting out its name from our local fauna, and in rendering it only a thing of the past.

MARCH 3rd, 1881, 2 P.M.

ANNUAL MEETING.

Dr GEIKIE, F.R.S, President, in the Chair.

NEW MEMBERS.

Mr William Ellison; Mr J. Sidney Farquharson; Mr William Hall, Perth, were elected Ordinary Members; and Mr Patrick Geddes, F.R.S.E., Edinburgh, a Corresponding Member.

NOMINATIONS.

Mrs Robert Pullar and Mr Keith were nominated for election as members of the Society.

Mr S. H. Ellison exhibited a piece of willow wood to show how the caterpillars of *Dicranura furcula* make their cocoons to imitate the bark; and the Secretary showed a "dust ball" (carbonate of lime) found in the stomach of a horse.

The following Annual Reports were then read:—

### REPORT OF THE COUNCIL.

The Council, in presenting its Fourteenth Annual Report, has to congratulate the members on the continued prosperity of the Society. During the past session six ordinary meetings were held, the average attendance at which was seventeen. During the session eleven papers were read, the number of authors being also eleven. Seven new members have been added to the Society during the past year.

Four excursions were successfully made during the past summer, the districts visited being—1. Dunsinnane Hill and King's Seat; 2. Small Glen, Amulree, and Strathbraan; 3. Farragon; and 4. Muthill and Drummond Castle. At all these excursions care was taken to insure the attendance of members able and willing to give practical demonstrations of the natural history and geology of the district visited, greatly to the advantage of the members who were present. Though at most of the excursions there was a fair attendance, the Council hopes that during the coming summer a still larger number of members will endeavour to participate in the benefits afforded by these opportunities of conjoined field-studies. To afford opportunity to members desirous of having more frequent practical instruction in collecting and studying, the Council will endeavour to arrange for a series of shorter and more frequent excursions, under competent guidance. Members desirous of taking part in these should give their names to the Secretary.

It is with much pleasure that the Council is able to allude to a fact which shows that there exists in the district an increasing desire for scientific research, as shown by a spontaneous movement to establish a microscopical branch of the Society. It is quite unnecessary to dilate upon the importance that the microscope has now acquired as one of the tools of the naturalist, and the Society is to be congratulated that it is now in a position, due to the liberality of its members and the public generally, to offer facilities for microscopical work.

The new Museum building in South Tay Street is now nearly completed, and though, owing to the severe weather that has been experienced this winter, great and unexpected delay has taken place in the work, it is yet hoped that the last meeting of this winter-session may be held in our new lecture-room. By the liberality of the subscribers to our museum scheme enough money has been raised to defray the cost of the building. Further funds are, however, necessary to furnish and endow the Museum, and, to raise these, arrangements had been made to have in September next the bazaar advertised so long ago as April, 1878. As promises of assistance from nearly one hundred Perthshire ladies had been secured, the bazaar seemed certain to prove successful; but on hearing that the promoters of another bazaar (to be held in October) had expressed themselves as much aggrieved, the Committee decided to postpone our bazaar till December, not wishing that any charge of unfairness (however unfounded) should be brought against it. The Council feels satisfied that the public will put the proper value upon such a sentiment, and respond all the more liberally (when the time comes) towards the objects the Society has in view.

### REPORT OF THE LIBRARIAN.

BY MR GEORGE YOUNG.

During the past year a good many books have been added to the Library, most of which have already been noticed at the ordinary meetings. Amongst them are the publications of several other Societies which have been received in exchange. As the proposals for exchange have in every instance been made *to* (and not *by*) our Society, the exchanges acquire additional value, as testifying to the success of our efforts in the advancement of natural science. The countries to which the various Societies, with whom we exchange, belong, include Scotland, England, France, Germany, Austria, Sweden, Canada, and the United States.

Though in previous reports the Librarian has been unwilling to complain of the miserable accommodation for his department that its present contracted quarters afford, he has not been unaware that the Library, in common with other parts of the collections, has in the past had many difficulties to contend with, and has consequently not been able to attain that degree of perfection which the flourishing state of the Society would otherwise have ensured. Now that with enlarged and appropriate accommodation a new era of increased prosperity seems to be drawing near for the Society, it is to be hoped that the Library will form no mean part of the general machinery for carrying out

the objects of the Society. Hitherto there has, for the reasons mentioned above, frequently been doubts as to the propriety of acquiring many desirable works; but, now that the obstacles to the increase of the Library have been removed, the Librarian would suggest the desirability of raising a fund to put and keep the department on an effective footing.

In connection with the matter of exchange, the Secretary read the following extract from a letter which he had received from Mr Alfred Lockyer, Hon. Librarian of the Epping Forest and County of Essex Naturalists' Society, and which he considered very gratifying:—"I have received from Messrs Blackwood, vol. 5, complete, of *The Scottish Naturalist*, and No. 1 of the new vol., and am much obliged to you for the generous construction you have placed upon your obligations, under the exchange scheme which we proposed. I did not know before that this admirable quarterly was the journal of your Society."

### REPORT OF THE TREASURER.

The Treasurer (Mr John Macgregor) reported that there were at present 178 paying, 4 life, 5 associate, and 16 corresponding members; and submitted an abstract of accounts, from which it appeared that the receipts for the year amounted to £76 8s, and the expenditure to £38 18s 5½d, leaving a balance in bank at 31st January of £37 9s 6½d.

The Balance-sheet will be found on another page.

### REPORT OF THE CURATOR.

BY COLONEL DRUMMOND HAY.

In laying before you the present report, I would first of all beg to express the great pleasure I have in being at last able to congratulate the Society on having obtained a proper Museum Hall. It has been, as I daresay you all well know, the Curator's lot, year after year, to have had to report and lament the utter improbability of the Society carrying out in the premises we have so long, though temporarily, occupied, the much-cherished scheme of the formation of a Museum of the Natural History of Perthshire; whereby not only would its own studies be greatly expedited, but instructive entertainment provided for the community at large. One result of the great advance in the study of natural science that has been made during the last quarter of a century has been to show that the most perfect, as well as the most useful, kind of *provincial* Natural History Museums are those which are devoted entirely to the natural productions of the district. In restricting, therefore, our museum to the Natural History of Perthshire, we are quite in keeping with the present advanced ideas of museum construction, and at the sametime, I trust, moving in the groove which may lead to the highest degree of perfection that a *Provincial* Museum can attain. How near and how soon that state of perfection may be reached, entirely depends on the individual exertion of each member of the Society; and as its Curator, I would strongly urge upon all the necessity of renewed energy in the work before us. At the same time, I have much pleasure in stating, that in prospect of our being so soon in occupancy of the new Museum building great exertions have already been made, and the collections which have steadily been going on for years past, with the object of a Museum in view, are being re-arranged. In addition, large donations from various members, including almost all the species of plants to be found in Perthshire have already been received. and are now being arranged and classified. Though the latter already form a large herbarium, members (and especially those addicted to botanical pursuits) must not think that more specimens will not be required. This is far from being the case, as it is extremely desirable that plants of every district of the county—in fact, of almost every parish—should be represented by specimens in the herbarium. There are also, I may mention, large collections of articulate and molluscous animals ready to be handed over whenever the Society is in a position to receive them, and steps are being taken to secure representatives of all the other divisions of the animal kingdom. And last, and certainly not least, the President has most kindly undertaken to see that the geological collection is made as perfect as possible. Under these circumstances, I think the Society may be most sincerely congratulated on its favourable position in taking possession of its new building.

### REPORT OF THE EDITOR.

BY DR BUCHANAN WHITE.

Though no new work has been published by the Society during the past year, the Editor has the pleasure of announcing that the Council has determined to try the experiment of publishing a volume of the "Proceedings of the Society," in which will be given an account of each meeting, and at least an abstract of the papers read. Reports of the excursions will also be included in the "Proceedings." The volume will be issued in annual parts.

Though it is now some years since the publication of *The Scottish Naturalist* was handed over to Messrs Blackwood & Sons, the conduct of the magazine still remains in the hands of the Editor, and several of the papers communicated to the Society have appeared in its columns, and received commendation from other scientific journals,—a fact worthy of notice as testifying to their intrinsic value. As appears from the report of his colleague, the Librarian, there is an increasing demand from other Societies at home and abroad for *The Scottish Naturalist*, or other publications of the Society, in exchange.

That the *Flora of Perthshire* has not yet gone to press, is not, the Editor ventures to think, a matter to be altogether regretted. Though in some respects it is desirable that it should have been published ere now, yet every season brings forth fresh facts regarding the plants of Perthshire, and what has been lost by the delay will be more than compensated for by the information gained. It is hoped, however, that now our "Flora" will soon be in the hands of the public.

Rev. Mr TAIT, St Madoes, in moving the adoption of the Reports, said it must have been a matter of great grati-

fication to all present to have learnt from them of the increasing appreciation by, and sympathy with, the Society in the city and county; and he was sure that the new Museum buildings—of which they were so soon to get possession—would tend to increase the interest that was felt in the Society and its doings. Now that there was room for a library, he hoped that the hint which was thrown out about the formation of a Library Fund would not be let drop. With regard to Colonel Drummond Hay's report, it must have been very annoying and tantalising to him that there was no room for arranging and exhibiting the different articles gifted to the Society, and of course that tended to diminish the enthusiasm of members; but he hoped that now that that difficulty was soon to be removed, the Curator would have the pleasure of receiving large additions in the different natural products of the county. He had much pleasure in moving the adoption of the Reports.

Ex-Bailie M'NEILL seconded, and the motion was unanimously agreed to.

On the motion of Mr ROBERT PULLAR, seconded by Mr HORACE SKEETE, a hearty vote of thanks was awarded the various executive officials of the Society for their services during the year.

ELECTION OF OFFICERS AND COUNCIL.

The following gentlemen were unanimously elected as the Officers and Council of the Society for 1881-82 :—

JAMES GEIKIE, LL.D., F.R.S., F.G.S., *President.*
Rev. A. MILROY, D.D.,
HORACE SKEETE,
A. B. SANDEMAN of Huntingtowerfield,
ROBERT PULLAR, F.R.S.E., } *Vice-Presidents.*
JOHN YOUNG, C.E., Tay Street, *Secretary.*
JOHN MACGREGOR, Perth Post Office, *Treasurer.*
Colonel H. M. DRUMMOND HAY, C.M.Z.S., of Seggieden, *Curator.*
GEORGE YOUNG, *Librarian.*
F. BUCHANAN WHITE, M.D., F.L.S., *Editor.*
ANDREW COATES,
MAGNUS JACKSON, F.S.A. Sc.,
S. H. ELLISON, } *Councillors.*

Dr GEIKIE, the President, then delivered his Annual Address, as follows:—

The Reports which have been read afford most gratifying testimony to the continued prosperity of our Society, and I have to congratulate you upon the approaching completion of our new Museum. Doubtless in our new quarters we may fairly anticipate even greater prosperity than we have had in the past. If we have made considerable progress under the adverse circumstances which have hitherto surrounded us, what may we not hope to accomplish now that these hindrances are removed, and we have been, or will shortly be, provided with all necessary facilities for the prosecution of our work,—thanks to the liberality of our friends and wellwishers. During the past session we have had a number of papers brought before us, some of them by members who appear for the first time as contributors to our proceedings; and I would again urge upon members the desirability of aiding the Society still further in this matter. One of the great objects of a local Society like this is the faithful chronicling of facts—the collection of observations such as any one of us may make, and the publication of these for the benefit of observers elsewhere. Your Council has now made arrangements for the printing of abstracts of our proceedings, which will contain condensed summaries of the results attained, while at the same time a selection of the more important papers will continue to appear as heretofore in the pages of our journal, *The Scottish Naturalist.*

The importance of having stated meetings at which papers are read and discussed cannot be over-estimated. They promote good fellowship, they stimulate the members to renewed exertions, they are highly instructive to beginners, and they serve to confirm others in the methodical and systematic prosecution of their studies. Indeed, we may say that such meetings are the evidence that a Society is living, and not moribund or dead. They serve, moreover, to awaken in the outside public a more intelligent interest in the study of natural science; and their importance is now so generally recognised that the number of local Societies like our own is being increased year by year. Many men whose names are now recognized as those of leaders in the paths of science have commenced their scientific careers in associations of no greater importance than our own. And it requires no prescience to predict that this will become increasingly the case in the future.

In my presidential address of last year I made an appeal to members on behalf of our Museum: that they would remember it in their walks and excursions. I now renew that appeal, and hope that vasculum, hammer, and bag will be busily employed in procuring additions to our collection.

Other matters affecting this Society are so fully and

ahly discussed in the reports which you have heard that I need not repeat what has already heen so well put before you. I would only say that the thanks of the Society are due to those gentlemen by whom the reports have been prepared for the great interest they take in the affairs of the Society, and the time and lahour they devote to its service. May they long he with us, and may their reports in the future continue to be as gratifying as they have been in the past.

Now that the prospect of obtaining a suitable Museum in which to display the natural resources of Perthshire is so soon to be realized, it behoves each memher of our Society, as I have said, to do his utmost to increase the collections which we already possess. These form an admirable nucleus, hut if we are to have such a collection as I sketched in outline in my address of last year, each of us must be prepared to work, and to work with a will. It has occurred to me, therefore, that I could hardly occupy your time to-day to better advantage than by throwing out a few hints as to how those of you who are "geologically-minded" may set about investigating the primeval history of Perthshire with most advantage to yourselves and our Museum.

The various rocks of which this county is made up are much more numerous than is generally supposed, hut they all helong to one or other of these "formations":—namely, Silurian, Old Red Sandstone, Carhoniferous, Miocene, Glacial, Postglacial, and Recent.

The oldest of these formations is, of course, the Silurian, which extends over all the Highland portion of the county. It consists of a great successiou of various kinds of schists (amongst which mica-schists predominates), gneissoze rocks, quartz-rock, flagstones, greywacke, grit, clay-slate, limestone, &c. All these rocks occur as hedded masses: they are arranged in layers or strata, which are usually inclined at a high angle; and not only so, but when the strata are viewed on the large scale they are seen to have a particular trend. That is to say, their edges or outcrops run in a more or less determinate direction, which is from south-west to north-east; so that in travelling by the Highland Railway you pass across the outcrops of the Silurian strata as near as may be at right angles. Now if we carefully noted upon a map all the various dips or inclinations of these Silurian strata which may be observed between Dalnaspidal and Dunkeld, we should find that sometimes the beds dipped to north-west and sometimes to south-east. For example, at and near Dalnaspidal the strata incline to north-west; coming down Glen Garry, however, we should note that the direction changes to south-east—a dip which, with some local irregularities, continues all the way to the Pass of Killiecrankie, where the beds rise up, as it were, and hegin to dip once more to north-west. Shortly after passing Pitlochrie the dip again changes to south-east, and then we cross a series of rocks in which little or no good evidence of dip can he ohtained,—the separate heds, when these can he distinguished, seeming to he frequently vertical, hut with an inclination to dip to south-east. And so at last we come upon the Birnam and Dunkeld slates, which there can he little douht occupy the highest position amongst the Silurian strata of Perthshire. Now, these various dips indicate the position of certain foldings of the strata, which, having heen originally laid down in horizontal or approximately horizontal layers, have come in time to be squeezed up into great undulations, so as to form a series of anticlinal axes and synclinal troughs. To trace out the direction of these vast crumplings of the strata, in a more detailed manner than has yet heen done, would he a most interesting and instructive task for the memhers of this Society. For it practically means the unravelling of the structure of the Highlands, and ascertaining the relative antiquity of the various rock-masses of which those mountain-tracts are composed.

While endeavouring to accomplish this object, the local geologist would make acquaintance with a great variety of rocks. He would come across quartz-rock, gneiss, and mica-schist in the Athole district; slates at Birnam; micaceous flag-stones, grits, and greywacke over vast tracts, extending from the borders of Stirling, across the Braes of Balquhidder, Loch Earn, Strathbraan, and north-east to the confines of Forfarshire. Limestone he would note in not a few places, as on the shores of Loch Tay, in Glen Lyon, in the Tummel below Loch Rannoch, in Glen Tilt, at Pitlochrie, and elsewhere. Besides these rocks, which are the prevailing varieties, the observer would encounter many other crystalline rocks, some of which are of metamorphic origin, while others are igneous. There are granite, diorite, felsite, quartz-porphyry, syenite, hornblende-porphyry, and many more. Were specimens of all these obtained, their localities and positions being carefully noted, it would be seen what a rich field of research lies open to the mineralogist and petrologist in the picturesque Highlands of this county.

Although no fossils have ever been recorded from the Silurian strata of Perthshire, I do not think that all hope of detecting them needs he abandoned. In many wide tracts in the Silurian uplands of Southern Scotland which used to be considered barren of organic remains, these have of late years heen discovered agaiu and again; and the same may well be the case with some

of the less metamorphosed portions of the Silurian strata of Perthshire.

I come now to say a few words about the Old Red Sandstone strata. These strata represent both upper and lower divisions of the Old Red Saudstone system. The lower division is by far the more abundantly developed of the two,—the upper series appearing only in the Earn valley near Bridge of Earn, in the valley of the Tay between Glencarse and Errol, and in the neighbourhood of Inchture, while the lower series forms by far the larger part of the lowlands of the county, the Sidlaw Hills being built up of the same. The lower series abuts against the foot-hills of the Grampians—a wavy line drawn from Aberfoyle north-east by Glenartney, Buchanty, and Dunkeld to the Reekie Linn near Alyth, forming the boundary between the Silurian on the one hand and the Old Red Sandstone on the other.

If we traverse the Old Red Sandstone from north-west to south-east, we shall find that the strata are arranged in a very defiuite manner. Along the flanks of the Grampians the beds are either vertical or highly-inclined towards the south-east, but as we follow them in this direction the angle of dip rapidly diminishes until about the middle region of Strathmore the beds become approximately horizontal. Thereafter, as we approach the Sidlaws, they begin to rise up, as it were, in the opposite direction,—dipping to north-west,—a dip which continues until we have passed the crest of the Sidlaws, when they again roll over and dip towards the south-east. Strathmore thus lies in a great synclinal trough, while the Carse of Gowrie runs along the crest of an anticlinal arch.

The lower beds of the series are best seen along the flanks of the Grampians, where they are largely made up of conglomerates, along with which occur bedded masses of igneous rock. These rocks are well exposed in the Isla to the north of Alyth, in the Ericht Water, near Birnam, at Buchanty, in the neighbourhood of Monzie and Ochtertyre, in Glenartney, and at Callander. Dipping underneath the more gently-inclined strata in Strathmore, the lower series rises up again to form the Sidlaws and the Ochils. In the Sidlaws the strata are largely composed of various kind of igneous rocks, chiefly porphyrites, with tuffaceous beds and ashy conglomerates. As we follow the series in the Sidlaws north-east into Forfarshire, sandstones, flagstones, and tilestones become more and more abundant, until they come to form the major portion of the hilly tracts. In Perthshire, however, the Sidlaws are formed essentially of ancient lava-flows.

The conglomerates of the lower series form an interesting study, and might well engage the attention of local geologists. It will be found that the stones are composed of many varieties, some of them derived from the Silurians and some from the Old Red Sandstone itself. It is clear that at the time of their formation the flanks of the Grampians formed an old shore-line, along which the conglomerates were accumulated as gravel and shingle banks. During the time of their formation local volcanoes poured out lavas upon the bed of the inland sea, and these, broken up by the action of the denuding forces, contributed no small proportion of the water-worn stones that now go to make up the conglomerates. It would be extremely interesting to form a collection of the various kinds of stone which occur in these conglomerates, and to trace out the parent-rocks from which they have been derived. It will be found that a large number have been brought down from the Highland hills, probably by rivers and torrents. I have, indeed, been led to believe that by far the larger proportion of the stones owe their origin to stream and torrential action; and the peculiar distribution of the conglomerates, and the very large size attained by the stoues in some places, together with their frequently augular and subangular forms, lead one to suspect that at the time of this accumulation glaciers may have existed in the Highland glens. In the Sidlaw Hills the conglomerates are not so strongly developed; but here and there, as in the hills above Kinfauns Church, they attain a considerable thickness.

The porphyrites, with their accompanying ashy beds, likewise afford a wide field for study. The slaggy character of the upper and lower portions of the ancient lava-flows is often beautifully exhibited, especially in Moncreiffe Hill, Callerfountain Hill, Dunsinane Hill, and many other localities.

As a rule, the sandstones of the lower series which extend throughout Strathmore show no fossil organic remains. Now and again, however, faint and imperfect traces of plants may be detected. It is worth noting that these sandstones often contain sporadic water-worn stones, and now and again a local bed of conglomerate makes its appearance. The whole series appears to have been deposited in a wide inland sea, upon the bottom of which the volcanic forces erupted bed after bed of molten rock. Upou the highly-denuded surface of the lower series rests the upper group of red sandstones which are seen in the neighbourhood of Bridge of Earn, at Clashbennie, and Inchture. It is evident that before they were laid down the lower series had been thrown into folds, faulted, and very much worn and denuded. It is probable, indeed, that the lower valley

of the Tay had actually been already sketched out. At Clashbennie the sandstones have yielded remains of fishes and crustaceans.

I have mentioned the Carboniferous as forming part of the geological series of Perthshire. The rock of this age, however, appear to be restricted to the small detached part of the county that adjoins Clackmannan and Stirling shires on the Frith of Forth.

Passing over all the strata of the Mesozoic or Secondary, of which we have no representatives, we reach the Tertiary or Cainozoic rocks. Of these the only relics we have are the great east-and-west dykes of basalt-rock, some excellent examples of which occur in our own neighbourhood. Two of the most marked begin in Moncreiffe Hill, and can be followed west by Aberdalgie and Gask to beyond Drummond Castle. They form most conspicuous features in the landscape, often rising up as a bold ridge above the general level of the sandstone-strata, which they intersect. They are the youngest of all the igneous rocks of our county, and are believed to belong to the Miocene or Middle Tertiary period.

As the rocks of these dykes form most durable causeway-stones and are the best of road-metal, they are quarried in many places, and thus admirable sections are available for study. It is particularly instructive to observe the alteration which has been produced by the igneous rock upon the sandstones which it cuts through. These latter are hardened, baked, and cracked at the line of junction—clearly showing the effect of great heat. The basalt-rock itself also tells its own tale in its peculiar structure. As a rule, the rock of the dyke is considerably coarser-grained in the centre than towards the side. In the centre it is generally coarsely crystalline and not unfrequently vesicular, while towards the sides it becomes finer in the grain, until at the point of contact it is often quite compact. These changes show the manner of cooling. It is evident that the sides of the molten mass in contact with the stratified rocks would cool most rapidly,—and the crystalline structure under such circumstances would not be so distinctly developed. Towards the centre the molten matter would consolidate more slowly, and thus the individual crystals would be better enabled to accrete, while the imprisoned gases and steam would give rise to the small cavities,—which resemble the similar cavities in pumice and common furnace-slag. The cavities, I may add, are now usually filled up with some mineral which has subsequently been deposited in them by the water which is always percolating through the pores and interstices of a rock.

I come now to the most recent of our formations, namely, the Post-Tertiary and Recent deposits. These are almost everywhere present, and yield in interest to none of the older rocks, which they overlie and partially conceal.

The oldest of the Post-Tertiary accumulations is the well-known till or boulder-clay, which in the districts outside of the Grampians is usually red, while in the Highland glens the prevailing colour is a pale greyish brown, inclining in some places to yellow and blue. In Strathmore and the low country generally it is as a rule a tough tenacious clay, destitute of bedding, and abundantly charged with subangular and angular boulders and stones,—many of which are smoothed and scratched. This till is the bottom-moraine of an old glacier-mass, and the direction in which the ice flowed can be determined by noting the course followed by the stones in the till. These stones have been rolled forward underneath the ice. In our own neighbourhood we find that they have all come from the north-west;—some from the Highlands, others from Strathmore. The prevailing red colour is due to the fact that a great proportion of the mass consists of the degraded and pounded materials derived from the glacial abrasion of the red sandstones and marls of Strathmore. When we enter the Highlands we find that the till is composed exclusively of Highland rocks, and that the colour is no longer red, but, as I have said, pale brown.

When the till is dug up, and the rock upon which it rests has been exposed, we may note that the surface of the latter is often roughly smoothed, polished, and scratched. And if we take the compass-bearing of those scratches, we find that they coincide in direction with that followed by the stones in the till. These scratched rocks are evidently the work of the old glacier, which, by dragging over its bed stones, sand, and clay, smooth, scratched, and polished its bed in the same manner as the modern glaciers of Norway and the Alps. It is not only underneath the till that these scratched rock-surfaces may be detected. We note them on the slopes, and even the tops, of some of the hills. I have seen them near the very top of Birnam Hill and many other hills in its neighbourhood, and they may be detected every here and there upon the very crests of the Sidlaws and Ochils. They prove that all this region was formerly buried underneath ice which overflowed from the Highlands, sweeping across hills up to a height of 3000 feet, and pressing out in a general south-east direction. Even when the scratches are absent, a practised eye will note how the rocks give every evidence of having been ground and abraded by some force pressing against them from north-west to south-east.

Overlying the till come the great sand and gravel-series — the kames and mounds — which are so well-developed, especially in Strathmore between Lindertis and Glamis, and again near Monzie, and Ochtertyre, and elsewhere. Contemporaneous with these are the great flats of sand, gravel, and clay of Strathmore and other regions in the low grounds. All these deposits were laid down during the melting of the great ice-sheet. They correspond to the gravelly moraines and torrential deposits of Switzerland and North Italy, and betoken a time when glaciers occupied the Highland glens, and great summer-floods deluged the low grounds.

More recent than these are the mounds and hummocks of earthy debris, coarse gravel, and angular blocks which occur in the Highland glens themselves. These last are the terminal moraines laid down by the glaciers as they slowly retired up their valleys, and finally melted away. Associated with these moraines we generally find high-level flats and terraces of gravel, which are evidently the work of the rivers when these flowed in larger volume, and were subject to greater floods, than now-a-days. I may mention that during the retreat of the glaciers the sea gained upon the land, and reached to a height of at least 100 feet above its present level. To this period belong the clays with Arctic shells at Errol, the brick-clays worked at Pitfour, and the higher terraces of gravel, sand, and clay that fringe the slopes of the valleys of the Tay and Earn in our own neighbourhood.

The recent deposits are typically represented by the buried peat-bed and carse-clays of the Earn and the Tay. The peat-bed (seen at the Friarton, and particularly well exposed along the banks of the Earn for several miles above its junction with the Tay) represents a time when the sea had again retired, and when the land probably extended further seawards than it now does. Much of the peaty matter is made up of drifted fragments of trees, especially fir and hazel. Now and again, however, we see rootlets penetrating the old soil, so that we may infer that the peat represents a former land surface liable to be flooded by the swollen rivers.

The overlying carse-clay is evidently an estuarine deposit, accumulated at a time when the sea-level stood some 45 feet or so higher than at present. It is interesting to note that the earliest relic of man in Perthshire — a "dug-out" canoe — was discovered underneath the brick-clay at the Friarton. Possibly other human relics may yet be discovered on the same horizon; and it might be well if some of our local observers would, after heavy floods, take the opportunity of examining the old peat-bed on the banks of the Earn. It is quite possible that they might be rewarded with other and not less interesting relics belonging to the earlier stage of what is termed the Neolithic Period. The occurrence of the canoe at the Friarton shows us that man was in occupation of this district at a time anterior to the formation of the carse-clays. He was here before the sea had risen to the 45-feet level, and no doubt paddled his canoe in water which covered the present site of Perth to a height of 30 feet, and when the tide flowed up to and beyond Stanley.

The latest deposits pertaining to the Recent period are the lower alluvial flats which border the present lakes, streams, and rivers,—and the peat-bogs. In these we read the history of the gradual changes which ushered in the present—a history which, I may say, is as yet only very partially worked out.

I have now sketched in very meagre outline the general geology of the county, in the hope that those members of the Society who are interested in the stony science may fill in the details as opportunity occurs. There is certainly no wide and abundant harvest for the palæontologist to cultivate in Perthshire. The strata are as a rule barren of fossils, but there is sufficient inducement to the hammer-bearing student to keep his eyes open, for it is quite possible that some happy discovery of fossil organic remains may await him. As I have said, no fossils have yet been recorded from the Silurian strata, while only a few ill-preserved specimens of plants and some fish and crustaceans have been obtained from the Old Red Sandstone. The Carboniferous strata are represented only in the small detached part of Perthshire on the borders of the Firth of Forth, and these rocks are doubtless more fossiliferous than those belonging to any of the other formations in the county. Near Bridge of Earn, in some dark shales which possibly belong to the very top of the Upper Old Red Sandstone or the base of the carboniferous, plants and shells are not uncommon. The clays of Errol are well known to geologists as containing a number of shells of Arctic character, and the fluvio-glacial deposits of the Carse might be searched more assiduously than they have yet been, in the hope of discovering more relics of the old marine fauna of the Ice Age. But, as will be readily understood, it is the student of physical geology who will find most ample scope for observation in Perthshire. He could desire no better region in which to begin his investigations, and we may look forward to the time when the opportunities afforded by this Society may induce an increasing number of the young to engage in this most fascinating branch of Natural History study.

APRIL 14th, 1881.

Dr GEIKIE, F.R.S., President, in the Chair.

NEW MEMBERS.

Mrs Robert Pullar and Mr Sydney Keith, Perth, were elected members of the Society.

The following gentlemen were nominated for election at next meeting:—Mr Thomas Hunter, Mr James Young, and Mr David Mackie, all of Perth.

The following paper was read:—

"*How Some Animals Spend the Winter.*" By Rev. Thomas Brown, of Collace.

The return of winter, and the change which it produces in the general appearance as well as the actual condition of Nature around us, naturally suggests the inquiry how do the lower animals, or at least some of them, spend the winter? How do they get on when the food supply has in a great measure, if not entirely, failed? and what becomes of them when they disappear, as many of them do during that season, from our sight? Where do they go, and how do they live? Passing over, then, the winter life of the insects, which is a subject too extensive to be dealt with in a paper such as the present, let us look for a little at what I may call the extraordinary winter life of some of our birds, mammals, and reptiles.

Many of our birds, to begin with them, live altogether upon insects, and others of them do so to a considerable extent. But in winter, as we know, there are not many insects to be easily found, and, therefore, if they are to exist at all, some special provision must be made for them. And accordingly, prompted by the instinct of migration which has been implanted within them, numbers of our birds follow their food to other countries, and spend the winter there. Thus, for example, of all our Hirundines, the swallow family, not one remains with us during the winter season. They all betake themselves to Africa, crossing by the Straits of Gibraltar, and continuing their journey in a westerly direction for the banks of the River Senegal, where, Mr Adamson informs us, they arrive after October, and where they remain during the winter, again making their appearance at Gibraltar between the middle of February and the first week in March, on their return to our own and other countries. Even our short-winged birds, whose powers of flight and endurance are by no means so great as those of the Hirundines, forsake us during the winter for other and warmer countries far more extensively than we are aware of until we note their absence from among us. Of our two fly-catchers, both leave us during the winter. Of our three chats, only one remains with us. Of our six thrushes, one leaves us. Of our twelve warblers, in which family is included some of our most noted song birds, eleven leave us during the winter, and only one, the robin, remains to cheer us with his presence, and sometimes with his song. And of our three wagtails, only one remains with us. Of these and other birds which leave us in the winter, by far the greater number take up their abode in North Africa, which may be regarded as the winter paradise of our own and other European birds. Others, again, do not extend their flight so far, and confine themselves to the Continent of Europe; while others pursue their journey as far as the shores of the Black and Caspian Seas, and the adjacent country. It is pretty well ascertained, for example, that the nightingale, when it leaves our shores, betakes itself to Palestine, Persia, Smyrna, and Aleppo, in all of which localities it has been found in great numbers during the winter. The cuckoo has also been found at Aleppo during its absence from this country; and as it is seen twice a-year in large flocks at Malta, there is little doubt that it spends its winter in Asia as a general rule, although it has also been found in North-west Africa. Our noisy friend, the corn-craik, spends his winter in Holland. And the blackcap, the greater pettichaps, and others of our birds, spend the winter in the vicinity of Rome, and in Italy generally. While a number of our birds, however, thus leave us to spend the winter in foreign climes, there are others which are bred in Norway and Sweden, and within the sweep of the Arctic Circle, which come to spend the winter with us, and which are never seen in this country during the summer months. These winter visitants chiefly belong to the hard-billed birds of the Insessorial order, such as the fieldfares, siskins, &c.; to the Grallatorial birds, such as the sanderling, turnstone, woodcock, and snipe, the two latter of which particularly remain with us all year, but receive each year large accessions to their numbers from Norway. And also the Natatorial birds, or swimmers, such as the wild-goose, wildducks, gulls, &c., whose feeding ground in the Far North has been sealed up by the arctic frosts, and to

whom therefore our winter is comparative summer. Thus, while the failure of the food supply compels some of our birds to leave us and spend the winter in foreign countries, it also leads others to seek our shores. Altogether, there are about thirty distinct species of birds which spend the *winter only* with us, and which leave us again in early spring for their northern homes. And thus the migration of the birds may be compared to the flux and reflux of the tides,—a continual stream setting northward in the spring, and recoiling southward on the approach of winter.

Besides our migratory birds, there are others of our animals, such as the bat, hedgehog, frog, toad, lizard, &c., which also feed, to a large extent, if not entirely, upon insects, which are not to be found in winter. As they cannot, like the birds, follow their food to other countries, they are enabled, during that season to do without it altogether; and they accordingly spend the winter here in a state of hybernation, or winter sleep, which varies in intensity and duration. Of all our animals, the winter sleep of the bat is perhaps the most profound, as it has been proved by experiment that while in that condition it does not even breathe. During the winter they are found hanging in clusters from the roofs of caves, houses, or any dark recess to which they can find an entranee, suspended by their hind feet, with their heads downwards, and their bodies covered over with their wings to maintain their warmth. The numbers in which they congregate together in these winter retreats of theirs is very considerable. On one occasion I saw 650 emerge in one hour from the space between the slates and the roof of a kitchen where they had taken up their abode. And as on my return an hour afterwards they were coming out as rapidly and regularly as before, there must have been at least 1500 assembled there during the winter.

The hedgehog is another of our animals which takes to itself a winter nap, almost as deep and unbroken as that of the bat. When the cold weather begins to set in, it rolls itself over and over among the withered grass and leaves, until it becomes a huge hay ball, and then it creeps into some snug place, at the root of a tree or hedge, where it spends the winter, no doubt to its own entire satisfaction. At one time I had a pet hedgehog, which, when it betook itself to its winter sleep, I put into a bandbox, and placed on a shelf, and there it slumbered in peace, until the return of the warm weather awoke it to activity, when it came out of its temporary house decidedly leaner, but otherwise none the worse of its sojourn.

Numbers of beetles also hybernate. Of these some, such as the dor beetles, on the approach of winter, bury themselves deep in the earth. Others, such as the water beetles, burrow down into the mud at the bottom of stagnant pools, and spend the winter there. While others again, such as the rose beetles, go to sleep during the winter in the crevices of walls, and beneath the bark of trees,—sometimes in a solitary state, and sometimes in clusters together.

The snakes and lizards hybernate beneath banks, or under manure heaps or brushwood. The toad prefers to take its winter sleep in some hole in an old wall, or in a burrow which it has made at the root of a hedge. While the frog, though closely allied to the toad, prefers a different winter residence, and consequently it goes to sleep during that season, in the mud, at the bottom of the pond which it has frequented during the summer. While the snail, weary perhaps of always carrying his house about with him on his back, creeps into some crack in the wall, to the side of which it glues its shell tightly, and there it spends the winter, beyond the reach of either cold or hunger.

Others of our animals such as the squirrel and dormice, which live mostly upon acorns and grain, are also deprived by the return of winter of their food supply, and they too hybernate. With them, however, the winter sleep is neither so deep, nor so continuous, as in the case of the animals I have already referred to. On the contrary they frequently awake during that season, and, as they would otherwise perish of hunger during their waking intervals, they lay up, during the summer, a store of their favourite food, of which they partake freely when they arouse themselves, and then retire again to rest. So that they spend the winter in alternate eating and sleeping, and thus contrive to get along very comfortably.

Such, then, is a brief outline of the winter life of some of our animals. And thus by the instincts of hybernation and migration, which are so different in themselves, but equally efficacious for the accomplishment of the end which He has in view, the great Creator supplies all their wants, and in doing so illustrates the greatness of His wisdom, and His power.

In the discussion which followed the reading of Mr Brown's paper,

Mr John Young said they had heard of how some animals spent the winter, but he would tell them how a dog spent part of the spring. A gentleman residing in the city possessed a dog of the fox-terrier race, which disappeared about three weeks ago, and it was only discovered the other day locked up in a room where there was neither meat nor drink. It was reduced to a perfect skeleton, and could hardly walk. Now, however, it was getting on as well as could be expected, being carefully

fed by its owner with milk and other nutritious food. He only called the attention of members to the instance, as he thought it a very wonderful thing how a dog could live 21 days without any sustenance.

The SECRETARY read the following letter, received by Mr Henry Coates, with reference to the paper which he recently read to the Society on pearl-mussels:—

Alyth, 7th February, 1881.

DEAR SIR,—Our mutual friend, Mr Thomas, has sent me a Perth newspaper containing the article contributed by you to the Perthshire Naturalist Society on mussels, which I have read with great interest,—I may say great personal interest. There is a stretch of the River Isla from its source down to its confluence with the Dean, a distance of about 14 miles, in which, so far as I have ever heard, there is no specimen of the Tay mussel to be found, This has astonished me, and some years ago (I have a reach of the Isla on my land extending to nearly two miles as the water runs) I set about making enquiry (1) whether the *solum* of the Isla along that country would suit for the plantation of the mussel; and (2) how it could be done.

Among others, I consulted Dr Buchanan White, and his opinion accorded with the possibility of having the Isla stocked with the mussel, and the probability also of its success. I was recommended for its practical application to consult and employ a person of the name of John Farquharson in Coupar-Angus, who is a heaven-born fisher of all the piscatorial species, and having had a long talk with Farquharson, I resolved to make the experiment. At first the trial was seemingly to cost me £10, but in the end it cost less. John undertook to transport from Balquhidder 3000 mussels, and have them placed in the Isla opposite my property all on the same day; and he having left a station on the Callander Railway with an early train, and I having a dog-cart ready for him with the arrival of the 10.30 train at Alyth, we were at the water-side by 12 o'clock. The mussels were placed in an ordinary box and well damped among themselves, but there was no moss or other material used to retain the water. I had the 3000 placed in the Isla in different places where it was likely they would naturalise, and the first place selected was heartily to the satisfaction of Farquharson, who displayed an extraordinarily intelligent acquaintance with the creature in all its habits. In one place where they could be seen many of them took at once to burrowing in the ground and standing in an erect position, evidencing life and adaptation; others again (and these were many) looked, to use a homely expression, "as if their tongues were hanging out," and never moved from the spot. This was all done in February or March of 1880, and during the summer of last year, though we did see a few dead shells, upon the whole, it cannot be said that there were many such,—leading, I trust, to the hope that the mussels have found a habitat congenial to them in the Isla.

You did not mention the Isla among the rivers that you had explored, and, as a scientific question, it has occurred to me that I ought to acquaint you with this experiment, and beg your opinion upon the probability of its being successful or the reverse.

May I add that I am a member of the Perthshire Society of Natural Science, and this will be my apology for intruding.—I remain, &c., WM. JAPP.

H. Coates, Esq.

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MAY 5th, 1881.

Rev. Dr MILROY, Vice-President, in the Chair.

The following books lately received by the Society were laid on the table:—*Journal of the Royal Microscopical Society*, February, 1881, April, 1881; and *Verhandlungen der k. k. Zoologisch-botanischen Gesellschaft in Wien*, vol. xxx., 2nd part.

NEW MEMBERS.

The following gentlemen were elected members of the Society:—Mr Thomas Hunter, Mr David Mackie, and Mr James Young. Dr Bendall, Perth Infirmary, and Mr Alfred L. Rowden, Perth, were nominated for election as members.

The following papers were read:—

1. "*Among the Trap-dykes on the Almond.*" By the Rev. Dr. Milroy, of Moneydie.

Any remarks that I may make on the trap-dykes that meet our view as we take a short stroll by the side of the Almond are not given as possessing a scientific value,—my chief object being to show by a practical example how those members of this Society who do not make science their special and exclusive study may yet contribute in some degree to the objects which the Society is designed to promote. To communicate papers valuable in a scientific point of view is the function of specialists, and must be confined to a comparatively small number; but the great majority of members, though not scientists, can yet make use of their eyes, and can tell something about the plants, animals, or localities with which they are familiar. And such contributions I regard as an important function of our Association. One member may be conversant with certain objects or localities which are comparatively unknown to

others. He may think them to be matters commonplace, and unworthy to be brought before the notice of the Society; but in the investigation of Nature no facts are worthless, if they be accurately observed and faithfully reported. The observers may not be able to draw from the facts all the conclusions which they warrant, but still, as far as the facts go, they have a value; and if members of the Society could be induced to observe, and report their observations, the papers would have a still more varied character, and would awaken a still greater interest.

I wish you to accompany me on a walk along the River Almond downwards for about a mile and a-half, beginning at Lynedoch. We first strike the river just above the site on which Lynedoch Cottage formerly stood, and we find that we have reached the stream at a place where it forms a long, broad, deep pool. Even in the driest season of the year, when the water in the river channel has shrunk to a rivulet, the water in the pool has an average depth of 10 feet. It is so still that you can scarcely detect the flow of the current; but below it and a little way above it, the stream is comparatively shallow, sweeping with a current more or less rapid over the stones and round the boulders that lie in the watercourse. Such is the difference which strikes the eye at once; let us try if we can ascertain its cause. If we go a few yards up the stream, we find an immense mass of trap forming the southern bank, and rising to a great height in a wooded knoll. If we are interested in the etymology of the names of places, we can see that the ridge formed by the trap must have presented very much its present appearance to the earliest Celtic inhabitants, for they called the spot Drumcairn, and it still bears its accurately descriptive appellation. The river has here first encountered this mass of trap, but finding the immense impediment too hard to be overcome, it slightly altered its course to the north, cutting a channel through the softer Old Red Sandstone in the vicinity of the trap. Soon altering its course slightly to the south, it has encountered the trap-dyke further down at a right angle at a more vulnerable point, and has there overcome the obstacle presented. The trap-dyke where the river cuts it is about 48 feet in breadth. The rock which the trap has pierced is Old Red Sandstone. The sides of the rock in contact with the trap are smooth and glazed and intensely hard. This induration is very marked both above and below the dyke, but decreases as we recede, until the rock resumes its normal appearance. As we look up the stream, we see that the current is broken by a fall, not where the stream crosses the dyke, but upwards of 30 feet above it; as we look down the stream, we see that the deep pool is not at the dyke, but is upwards of 30 feet below it, though in the narrow channel—in which water is continually running even in the driest periods of the year—the rock has been worn away to within six feet of the dyke. Can we explain those phenomena? The stream in flowing to the sea had to cut through this mass of trap and hardened sandstone. The softer rock down the stream has been worn away by the action of the water much more rapidly than the whinstone dyke and the indurated sand-stone in its immediate vicinity. Hence we have the deep pool below, and the hardened rocks, trap-dyke, and narrow channel above. I have already said that the sandstone has not yet been worn away up to the dyke, but the wearing process is slowly and continuously advancing, and can in some parts be seen to great advantage. The layers are of different degrees of hardness. Sometimes a layer of softer texture is surmounted by a layer of harder material. The water has washed away the lower, and has left the upper layer overhanging without support. This unsupported portion falls away in larger or smaller pieces,—and in this way the sandstone is gradually retreating towards the dyke.

Having examined the dyke which crosses the course of the Almond at this spot, and the effects which it has produced, let us walk down the riverside for about a mile, when we reach Dalcrue. Here, too, we see how expressive and true to nature the old names of places are. Those who first called the spot Dalcrue must have seen in it the same physical features that now present themselves to us —the deep river gorge and the steep wooded banks. The scene from the bridge which here spans the river is exquisitely lovely. On one side a view opens up of wood and glade, spacious parks and glancing water leading up to a spur of the Grampians; on the other side we look down into a deep dell, through which the river is flowing between high and nobly wooded banks. After gazing on the distant view let us look over the bridge, first on the one side and then on the other. Looking down from the upper side of the bridge, we see a comparatively shallow (of course I speak of the Almond in its ordinary condition), broad stream running over a stony channel. Looking down from the lower side, we see an immense deep black pool reaching far down the river. We have here exactly the same phenomenon that we saw up at Lynedoch. If we turn to the east, we see right before us a bold bluff precipice of Old Red Sandstone rising sheer up from the road at the end of the bridge. A cursory glance enables us to see that the sandstone is traversed by a trap-dyke about 38 feet in breadth. Here, too, the trap has left evident marks of its intense state of heat. The glazed face of the sandstone in contact with it, its hardness in

immediate proximity to it, the ring that it gives to the stroke of the hammer, all tell the same tale. If we now descend to the bed of the river, we see that the trap-dyke crosses the stream almost in a line with the bridge, and that the deep pool which we noticed from above has been formed by the same causes and in the same manner as the one which we first examined.

Continuing our walk down the riverside for about half-a-mile, we find another remarkable trap formation occurring at the dam-dyke above Cromwell Park Works. The trap rises sheer from the river, and a very fine section is laid bare on both sides. Columnar formation is here distinctly perceptible. The columns are of course arranged horizontally, or at right angles to the cooling surface. The dyke is about the same breadth as the one which we saw at Dalcrue, and presents even more distinct marks of its igneous origin and molten state. The rock which it pierces is a soft marl, and the hardness of the rock in contact with the trap presents a marked contrast to its soft condition a few feet distant. On looking at the bed of the river here, we see neither trap-dyke nor deep pool below the line in which the dyke must run. There was a deep pool at this spot, but it has been filled up to allow the dam to be constructed. From what we now see, we may learn the value, in a practical point of view, of a little acquaintance with Nature's mode of working. Where the pool has been filled up the channel of the river is floored with large stones, carefully dressed and laid. This flooring was at first placed with the stones sloping downwards with the current. The result of laying them down in this position was that the first big spates wrenched them out and swept them away. Taking a lesson now from the manner in which Nature slopes the stones in the bed of a stream, the builders replaced the pavement, making the stones slope in the opposite direction. The result of following Nature's plan has been that the biggest floods roll over the stone flooring without inflicting damage. The materials for filling up the pool were quarried out of the trap-dyke by the riverside. An enterprising individual, on seeing the hard and strange character of the rock in the immediate vicinity of the trap, imagined that he had discovered a stone which would do admirably for road metal. A quantity was quarried and duly broken. Unfortunately for the success of the experiment, the indurated marl, on being broken into fragments and exposed to the action of air, rain, and frost, speedily resolved itself into its original state of mud. These two facts, which I have from undoubted authority, show the advantage in practical matters of some knowledge of Nature and her mode of operation.

Resuming our walk, a few steps bring us to another dyke. I shall detain you here only a moment, in order to show that the stream has at this spot washed away the dyke itself, and has left the indurated sandstone which was in contact with it to form the sides of a narrow deep pool, which bears the appropriate name of "The Black Kist."

It would give me pleasure to take you further down the river, and point out to you the high cliffs of red sandstone rising on both sides; but the limits which have been most judiciously prescribed to papers read before this Society are now almost reached. At the bridge at Almondbank, another notable trap-dyke appears crossing the river. The features with which we are now familiar are here also presented to us. I pass them over. An easy and pleasant walk from Perth will take you to the spot, and the scene will amply repay the trouble.

We have thus in less than two miles passed five trap-dykes, and we may see—1. That they all run in the same direction. 2. They are of more recent origin than the sandstone which they have penetrated. 3. The piercing of the sandstones by the trap has not in general altered their dip at the point of contact. The first dyke, however, which we visited shows an alteration of the dip of the sandstone at the point where the river first impinges upon the trap. 4. Though the igneous action which sent up these dykes has ceased, the process which has hollowed out the pools, and cut the rocks, and formed the steep and precipitous cliffs, is still in operation. Old men tell us that they can discover little or no change that has been wrought in their day, but the threescore years and ten are only as a moment compared with the vast epochs necessary to produce the results which have been disclosed to us in the scenes which we have now traversed.

2. "*Some Suggestions anent Specimens for the Museum.*"
By Dr Buchanan White, F.L.S.

Though in several of his addresses our President has, in his usual lucid manner, given a description of the plan on which our Museum is to be arranged, and has pointed out in what manner members may assist in procuring specimens of the natural productions of Perthshire, it has occurred to me that a few more words may not be amiss at the present time, when we are just on the eve of entering into possession of our new building. As most of you are aware, one of the objects of the Society is the acquisition of a collection—as perfect as it is possible to make it—of all the animals, plants, and rocks of Perthshire, with the view not only of thereby showing in the most evident manner (*i.e.*, by the specimens themselves) what these are,

but of illustrating from examples to be found all around us, and within the reach of everyone, the grand scheme of creation in so far as it pertains to the domain of natural science. But it is not on this aspect of the Museum that I wish just now to address a few remarks to you. It is rather on the subject of the collections considered as *Perthshire collections.*

Perthshire, as you may well imagine, does not contain many plants or animals that are not to be found in other parts of Britain, though it does really possess a few. Nor does Britain contain many that are not inhabitants of the rest of Europe; nor again, Europe, many that are not to be found in other parts of that great region called the Palæarctic Region, which stretches from Britain to Japan, and from the North Pole to North Africa and the Himalaya. Therefore, in the *kinds* of plants and animals we will not be able to show in a Perthshire collection anything that might not be seen in a general British, or European, or Palæarctic collection; and supposing that we had a list of what is to be found in Perthshire, we might by procuring specimens elsewhere be able to show examples of the kinds of animals and plants that are to be found within our boundaries without having a single Perthshire specimen amongst them. But to the scientific naturalist, who looks upon specimens as illustrating far more than classification, form, or structure (highly valuable as are specimens considered in this light), such a collection—gathered it may be from the four winds of heaven—is of infinitely less value than one in which every example has a local history, and serves to illustrate the peculiarities of a special district. At the present day great and just importance is attached to a knowledge of the geographical distribution of plants and animals. It assists not only in casting light upon the past history of the earth, and the various alterations in climate, &c., that have taken place, but also suggests ideas as to the relationship and origin of species. To exhibit in anything like its full extent this geographical distribution would tax the utmost resources of a large national museum, so that we need not for a moment dream of attempting it; but we can all the same do our part in the work by illustrating the distribution within the limits of our district. This, if carried out to the best of our ability, cannot fail to be most interesting and instructive to ourselves, and of great value to any naturalist who happens to visit our Museum.

Though, as mentioned above, few of our plants or animals are not to be found in other parts of Britain, it does not necessarily follow that they are to be found in all parts of this island. Some of them attain their northern limit in this county, others their southern, or their eastern, or their western; and it may and does happen that species which thus find their limit of distribution here may consequently be of rare occurrence with us. To show, therefore, that they *do* occur, it is very desirable that they should be illustrated by local specimens, and that, hence, no doubt can be cast upon their having occurred, as might be urged if the evidence was merely a name in a list. But within the county itself there is a considerable amount of variation in the distribution. As you are aware, the altitude of Perthshire above sea-level ranges from 0 to 4000 feet, with corresponding differences in climate; you are also aware that the geological formations are of various kinds, and these, combined with the range of altitude, have a considerable influence on the distribution of species. Some seem to range throughout, others are limited by altitude, and possibly by the geological formation. How far these causes affect the distribution remains to be more completely ascertained: and there is no surer method of finding this out than by the formation of collections from all parts of the county. If this is done, great light will be shed not only upon the agents which regulate the local or Perthshire distribution, but, I believe, more or less upon those which affect distribution in very much wider areas.

Another very important matter that will be shown by making full collections of our local plants and animals is the amount of variation in specimens of the same species inhabiting different parts of the county. The range of variation and its causes is a subject of paramount importance, and which, though perhaps most strikingly shown in specimens from different countries, yet to be understood (and it is far from being yet explained) must be studied in its initiatory stages, as exemplified in the variations shown by specimens from various parts of the same district. We in Perthshire are peculiarly favoured by having a district ranging through such different altitudes, and consequent changes of climate, &c. In some species the variation between (say) Highland and Lowland specimens is so striking as to be evident to the not very critical passer-by; but in other cases it is not apparent till specimens are placed side by side, when it at once becomes conspicuous. Hence the great importance of making collections which will show whether there is any variation in specimens from different parts of the county. But it is not sufficient that we should have specimens from those parts of the district which present the most opposite conditions of altitude and climate. It will not suffice, for example, to have specimens from two such very different places as Invergowrie and Ben Lawers. We must have them from many intermediate localities; so that we may see by what steps the variation (if there is any) takes place,

or in what locality it begins. When we have ascertained this for a number of species,—and this we can only do by forming ample collections,—we will doubtless be able to obtain a glimpse of the causes which effect the variation.

Having now endeavoured to show why it is desirable to form extensive collections of the Perthshire plants and animals, and to point out that the object of our Museum should be not only to afford an instrument of education to all who desire to learn, but if possible to be a means of adding something to human knowledge, let me offer a few suggestions as to how the collections are to be gathered together.

If we had plenty of money, it would be an easy matter, but, as it is, we must depend upon the exertions of individual members; and though our progress may be slower, the work, I have no doubt, will be more thoroughly accomplished, as it will be a labour of love. To demonstrate most effectively the distribution of species in Perthshire, it is necessary to divide the county into certain districts. In one of the early works published by the Society, a certain division into districts was adopted, and, with slight modifications, these divisions have been retained in a large map of Perthshire which has been prepared for the Museum. In the first place, the county is very naturally divided into two great districts—one lowland the other highland—by the line which separates the Devonian from the Silurian geological formation. This line passes through the county from south-west to north-east, and runs along the foot of the Grampian hills. If we stand on Kinnoull Hill, or any other of the Sidlaw or Ochil ranges, we can see at a glance the line of demarcation between these two great districts—the Devonian or lowland, and the Silurian or highland. These constitute by far the most important divisions, and their subdivisions are more for the sake of convenience than of indicating any striking differences in the distribution. To this, however, there are exceptions. For example, the district which we call "Gowrie," and which includes all parts which drain into the *tidal* portion of the Rivers Tay and Earn, is in many respects peculiar. Again the districts situated in the basin of the Forth have several points of difference from those in the basin of the Tay. Moreover, the districts situated to the east of the Tay, Tummel, and Garry differ in some respects from those to the west of these rivers. The districts, then, into which we divide Perthshire are as follows:—

1. Devonian Forth, and 2. Silurian Forth, including respectively the lowland and the highland districts of the Forth basin; 3. Devonian Earn, and 4. Silurian Earn, separated as Forth is; 5. Gowrie, as defined above. Then, on the east of the Tay and Tummel, 6. Devonian Isla, and 7. Silurian Isla, being the lowland and highland division of the country lying between the watershed of the Sidlaws and the watershed (south) of the Tilt; 8. Athole, which includes the basin of the Tilt and most of the basin of the Garry; 9. Rannoch, including the greater part of the basin of the Tummel and Lochs Rannoch and Ericht; 10. Breadalbane, which contains the basin of the Tay from Logierait upwards, including the River Lyon and Loch Tay and its tributaries; 11. Devonian Perth, and 12. Silurian Perth, embracing respectively the lowland and highland divisions of the district lying west of the Tay and between Breadalbane and the two Earn districts; and finally 13, Lomond, the small part of the county which drains into Loch Lomond. As will be seen, the divisions between these districts are well marked in most cases, and can easily be kept in mind in working at the fauna and flora. These districts, moreover, are well calculated to illustrate in a full degree many of the peculiarities of distribution. In forming our collections, therefore, the first thing to be aimed at is to obtain a series of specimens illustrative of each of these districts. I say a series of specimens, for, except perhaps in the case of birds, which can move rapidly from one district to another, it is not desirable in most instances to base comparisons upon single individuals, and it is as easy to obtain and preserve several specimens of (say) a plant, an insect, or a mollusc, as one only. But in addition to illustrating the district in general, it will be well to keep in view the importance of obtaining specimens from various parts of a district. In Gowrie, for example, specimens ought to be obtained from four or five localities, say, from the banks of the river at Invergowrie and at Perth; from places more inland; and from the summits of the Sidlaws. By this means the variation, if any exists, within a district can be ascertained. This, of course, applies only to species which are to be found in all the localities cited. As a matter of fact, it is only a comparatively small number that can perhaps be obtained in all the localities.

It is unnecessary, I think, to dwell further on this subject, as it must commend itself to everyone. We must now consider how the specimens are to be obtained. This, as already said, must depend on the assistance given by the members. I am glad to be able to report that assistance has already been promised and given by several members in different parts of the county; but if we are to carry out the scheme I have sketched of a full representation of all the districts, we will require all the assistance we can get. We cannot expect, I need hardly say, to form our collections in their complete state all at once. That, indeed, will require ample time, but by working steadily

on, and keeping the end in view, we are sure sooner or later to attain the goal, and that goal should be the making of our Museum the most perfect local museum in Britain. It is not necessary that those members who desire to help should know much of the subject—at least to begin with. It is not necessary that they should endeavour to name the specimens;—that will be done when they are deposited in the Museum. But if they will set to work to collect, I hope and believe that they will be led on to study, and thus, in helping the Museum, help themselves to greater knowledge and greater pleasure. Nor is it necessary that one who desires to help should be asked to devote a lot of time and trouble to the work. The more numerous the specimens are the better, but contributions of single specimens will be heartily welcome. But be the specimens numerous or few, it is of importance that *each should be accompanied with a note of the place where, by whom, and when*, collected. Without at least the first of these, the specimen is of little use.

When I began these notes, it was my intention to have said something about the means of collecting and preserving, but on consideration I think that all I could say here would not prove of much use. I might mention that plants can be easily dried by being pressed between sheets of blotting paper, and that it is desirable to take roots and all, at least in the case of small plants. I might also mention that land and water shells only require to be dropped into boiling water, and the animal extracted by means of a pin, both of which operations being in the case of small shells, unnecessary. But for other organisms, such as insects, a little more preparation is necessary; and it seems desirable that anyone desiring instruction in the method of preparing them should communicate with the Secretary, who will take steps to insure that some qualified member shall give the instruction asked for. In the case of quadrupeds, birds, and other fleshy animals, the donor had better send the specimens in a fresh state to the Secretary, who will see that they are preserved.

Before concluding these remarks, there is one point in connection with our local natural history to which I wish to call the attention of observers, in the hope of eliciting information. The point in question is, how many species of bats are natives of Perthshire? In the interesting paper that Rev. Mr Brown gave us at our last meeting, he mentions having seen an immense quantity of bats emerging from their winter quarters, but he does not indicate what species they belonged to. Four kinds of bats have been met with in Scotland, but of these only two, so far as I know, have been noticed in Perthshire. These two are the Common Bat *(Vesperugo pipistrellus)* and the Long-eared Bat *(Plecotus auritus)*, and it would be interesting to know what their distribution is in the Highland districts. But there is another bat which is almost certainly a native of Perthshire, as it is widely distributed in Scotland. This is Daubenton's Bat *(Vespertilio Daubentoni)*. This species is slightly larger than the Common Bat, and has certain structural differences, amongst others, the outer edge of the ear being only very slightly notched, instead of deeply notched, as in the Common Bat. In its habits it is so peculiar that, though really abundant, its presence may be easily overlooked. The peculiar habit in question is that of skimming along over the surface of water, scarcely flapping its wings, but vibrating them rapidly, and almost touching the water. I hope, therefore, that members will be on the lookout for a bat with these habits, and if they come across one endeavour to secure specimens for identification. Of the fifteen bats that have been met with in Britain, it is not perhaps very likely that any but the three above mentioned occur in Perthshire. Still a lookout should be kept for them, as another species, the Reddish-gray Bat *(Vespertilio Nattereri)* has recently been met with plentifully near Dalkeith. This is larger than the Common Bat, and paler in colour.

I have been tempted to bring forward this subject, as bats are especially creatures of the summer, and it is desirable that we should endeavour to learn something about the Perthshire species without loss of time. In addition, however, to looking after bats during their hours of flight, they ought to be searched for in their hiding-places, where, moreover, their capture would be easier.

In conclusion, I would beg members to keep in mind the old fable of Hercules and the waggoner. The Society has obtained an excellent Museum building; it is already in possession of several valuable collections, and it has promises of more; but if the Museum is to be worthy of the name, if the Society is to carry out the objects for which it was founded, every member must put his shoulder to the wheel, and, not content with calling upon others to do the work, help it on to the best of his ability, ever remembering the motto of the Society, "Whatsoever thy hand findeth to do, do it with all thy might."

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## SUMMER SESSION, 1881.

The following Excursions were made :—

JUNE 2nd.

1. *To Abernethy and Mouth of the Earn.*

Starting from Abernethy, the party proceeded to the side of the Tay a little below the mouth of the Earn, where the peat bed that underlies the carse clay is well exposed.

This peat bed has been carefully studied by Dr Geikie, who, in his *Prehistoric Europe*, devotes several pages to a description of it and the information it affords. The relation of the various strata at this point, to each other, are as follows :—Forming the foundation are rocks of Old Red Sandstone age, on which rests a mass of till or boulder clay deposited as the "bottom-moraine" of the last ice sheet that overflowed the Tay valley. Next comes a series of gravels, shingles, and brick clays laid down when the ice had disappeared but when the climate was still very cold, and when the sea reached a height of about 100 feet above its present level. It is to this period that the arctic shell-beds of Errol belong. At this time there were many glaciers amongst the Perthshire hills, and in summer the rivers would be greatly swollen by the melting of the ice and snow, and large quantities of gravel and shingle were brought down by the floods. Upon these gravels and brick clays are another series of gravels, sand, and silt, which, from the way they are deposited, were evidently laid down by the river without the assistance of the sea. The sea was then at a rather lower level, and though possibly not very much lower than it is at present, still it was sufficiently low to admit of the river cutting for itself a deeper channel. There is no special evidence as to what climate prevailed during the long period during which these river gravels were being laid down, but such as there is would indicate one somewhat like the present.

The next layer is that of the peat bed in question, which may be said to extend over the whole Carse of Gowrie from Dundee to Perth and for a considerable distance up the Earn, and varies in thickness from a few inches up to several feet. This peat was evidently formed in part in the place where it now is, as the remains of trees which grew there can still be seen rooted in the silt below, though in other places the peat has been carried by water to where it now lies. At this time the sea was at a much lower level, and consequently the shore line was much further off. As for the climate, it was probably more genial than at the present day. It is in this peat that the oldest evidence of the existence of the earliest human inhabitant of Perthshire has been obtained, in the form of a "dug-out" canoe which was found many years ago in the Friarton brick-field. Though the canoe in question is the only one of which record has hitherto been made in connection with the Tay, it seems that two others have been found in the Tay itself. For information regarding these we are indebted to Mr Pitcaithly, Elcho Castle. According to that gentleman, these canoes were made of oak, though the one found at Friarton appeared to be of pine.

Above the peat bed lie the deposits of clay and silt known as the Carse clays, which vary in thickness from 10 to 40 feet. These clays, which cover an area of not less than 35 square miles, show that the climate was considerably different both from that which prevails at the present day and that which prevailed during the time that the peat was being deposited. The sea then stood at a much higher level—45 feet at least above present mean tide; consequently, the whole Carse would be an arm of the sea, into which the rivers, greatly swollen, brought down immense deposits of fine silt derived from the grinding of the Highland rocks by local glaciers. The climate was much colder, and there was probably also a larger rainfall.

After the laying down of the Carse clays, the sea again gradually retreated, and the river deposited the terraces of gravel, sand, and silt, which remain as evidences of the gradual alteration in the height of the river and the sea.

Crossing the Earn, the party proceeded to explore the west bank of the Tay. The zoologists of the party found the objects of their study rather conspicuous by their absence, but the botanists were more fortunate. Nearly one hundred species of flowering plants were observed during the excursion, of which the following are the more interesting :—*Caltha palustris* (the marsh marigold, or king cup), a common enough plant, but remarkable for the immense profusion in which it grows on the swampy sides of the river. The variety called *Guerangerii*, which has hitherto been but seen very rarely in Perthshire, was found to be very abundant. *Trollius europæus* (the globe flower), with beautiful golden ball-shaped flowers; *Cardamine amara* (Bitter Cress); *Lepidium Smithii; Cerastium triviale* var. *holosteoides*, a very local British plant; *Comarum palustre* (Marsh Cinquefoil); *Œnanthe crocata*, reputed

to be very poisonous; *Myrrhis odorata; Sedum telephium; Crepis paludosa; Mimulus luteus*, an American plant, now perfectly naturalized on the banks of the Tay; *Symphytum tuberosum* (Tuberons Comfrey); *Typha latifolia* (Mace-reed); *Elodia canadensis* (Water Thyme or American Waterweed), an American water plant, which very mysteriously made its appearance in Britain about forty years ago, and spread rapidly over all tbe country, impeding navigation in some of the Englisb rivers. It is now reported to be as mysteriously disappearing. *Scirpus lacustris* (Bull-rush); *Scirpus Tabernœmontani; Glyceria aquatica*, &c. Among cryptogamic plants, the beautiful little *Æcidium rubellum*, which is parasitic on dock and sorrel leaves, was observed. It has apparently not been recorded from Perthshire before. The parts of the leaf attacked by it become of a brilliant crimson, on which the whitish cups are seated.

On reaching Elcho Castle a halt was made to examine this interesting old building,—Mr Pitcaithly, the tenant, very kindly explaining to the party some of the peculiarities of the place. After a short rest, the exploration of the river bank was continued as far as Perth, where, after an inspection of Lord-Provost Hewat's pretty garden at Craigie Park, the excursion was brought to a satisfactory conclusion.

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JULY 7th.

2. *To Craig ma Grianich, near Lochearnhead.*

Having reacbed Killin Station at 10 A.M., the party proceeded to investigate the marshy shores of the little lochan close to the station. Here a variety of more or less interesting plants were seen, including tbe true cranberry (*Oxyeoccos palustris*), with its bright red flowers, and a number of sedges belonging to the genus *Carex*, of which the more noteworthy were *C, limosa* and *C. pauciflora.* The ascent of the bill called Craig ma Grianich (or, in the Ordnance Map, Creag mac Ranaich), was then commenced till an altitude of about 2000 feet was attained, when some of the commoner alpine plants began to appear. Amongst those noticed were several kinds of saxifrages, such as the Starry Saxifrage (*Saxifraga stellaris*), with pure white flowers, dotted with red; the Opposite-leaved Saxifrage (*S. oppositifolia*), witb rich purple flowers; and *S. aizoides*, with yellow orange-spotted-flowers. In marshy places the beautiful little Alpine meadow-rue (*Thalictrum alpinum*), with dark green glossy leaves, in the style of a maidenhair fern, was common; while from the rocks numerous bushes of the Rose-root (*Sedum rhodiola*) displayed their pale glaucous green leaves and yellow flowers.

As it is usually on rocks that the rarer alpine plants occur, the attention of the party was chiefly directed to an investigation of that part of the hill, but, on examination, the rocks, though highly picturesque and piled range above range in a castellated manner, were found to be, on the whole, too dry to afford a suitable habitat for tbe rarer plants. In addition to those already mentioued the following were noticed:—The Alpine Cudweed (*Gnaphalium supinum*), Alpine Lady's Mantle (*Alchemilla alpina*), *Juncus triglumis*, Holly Feru (*Polystichum lonchitis*), Green Spleenwort (*Asplenium viride*). Viviparous Knot-grass (*Polygonum viviparum*), Mountain Sorrel (*Oxyria reniformis*), Small Tway-blade (*Listera cordata*), &c. In the peat mosses the pretty red fruit (unripe) of the Cloudberry or Averon (*Rubus chamœmorus*) was not unfrequent; aud in marshy spots could be seen the white spikes of the Mountain Bog Asphodel (*Tofieldia palustris*). Amongst the lower cryptogamic plants a few interesting species were found, such as the pretty moss *Tetraplodon mnioides* growing in thick clusters on bones (the place on which it usually grows), and accompanied by the rare fungus, *Peziza axillaris.* As parasites on the crow-berry two other rather rare fungi were also observed, viz., *Uredo empetri*, which forms small yellow spots on the uuderside of the leaves; and *Rhytisma empetri*, which blackens, and eventually kills, the stems.

For the zoologists the day was rather unproductive. The only wild mammal noticed was the mountain or blue hare, which was common. Birds (except grouse) were, as usual on the hills, scarce, though the wild note of the Ring Ouzel or Mountain Blackbird (*Turdus torquatus*) were occasionally heard, and a few specimens of the bird itself seen. There was far too much wind to allow insects to move abroad, though a few species were noticed, includiug the hill-frequenting moths, *Coremia munitata* and *Larentia salicata.* The great sub-kingdom Mollusca was represented by a single specimen of the black slug, *Arion ater.*

From the higher parts of the hill magnificent views were obtained in every directiou. On one side part of Loch Tay, flanked by tbe rugged ridge which includes Craig Caillich, Cam Creag, Meal nau Tarmachan, Ben Ghlas, and the great Ben Lawers, and bouuded by the dark-wooded Drummond Hill, beyond which towered Farragon and the hills of Athole and Aberdeenshire; in front, Loch Earn, overshadowed by Ben Voirlich, and backed by the

picturesque Comrie hills, beyond which a wide extent of lowland country, reaching to the Sidlaws, was visible; to the south, Ben Ledi and the Braes of Balquhidder; and behind a wide-stretching array of great peaks and mighty bens, from Ben More, close at hand, to Glen Coe, in the distance, made up a landscape to be long treasured in the memory.

The excursion ended at Lochearnhead Station, from which the party proceeded homewards, delighted with the pleasant ramble over the heather and amongst the rocks of Craig ma Grianich.

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AUGUST 11th.

3. *To Farragon, near Aberfeldy.*

The party was conducted by the Rev. Mr M'Lean, minister of Grantully; the geology being demonstrated by Dr Geikie, President of the Society; while Colonel Drummond Hay and Dr Buchanan White pointed out the more interesting zoological and botanical objects.

To allow as much time as possible for exploration, a start was made by the 6.50 A.M. train for Grantully, from which the ascent of the hill was commenced. Amongst the less common plants noticed dnring the first part of the ascent were the somewhat local Field Chamomile (*Anthemis arvensis*), *Campanula latifolia*, a kind of wild Canterbury Bell with large blue flowers, and the Great Mullein (*Vcrbascum thapsus*), with its handsome spike (2–3 feet long) of yellow flowers. After passing the higher-lying cultivated fields, some of the boulders lying beside the rough road attracted attention. One of these was found to consist almost entirely of the ore of some metal, probably zinc and copper, mixed with mica, aud forming very handsome "specimens." Soon after this the opeu moor was reached, and the plants peculiar to such situations began to appear. Amongst others were noticed the Frog Orchis (*Habenaria viridis*), a not very common plant; the Field Gentian (*Gentiana campestris*); the upland variety of the pretty little Eyebright (*Euphrasia officinalis*, var. *gracilis*); the Round-leaved Sundew (*Drosera rotundifolia*), and many others.

After crossing a wide moor of heather, Loch Derculich, a rather considerable sheet of water, 1500 feet above sea-level, and famous for its stock of fish, was reached. Here it was expected that some interesting water-plants might be found, but the expectation was vain. The only plant of any interest that was noticed here was *Veronica scutellata*, a species by no means uncommon at a lower level.

Loch Derculich, like most of the lakes in the Highlands, owes its origin to ice action, its bed having been scooped out by a glacier, the moraines or heaps of debris accumulated by which may be seen piled up all round it. From the loch Farragon lies in a north-westerly direction, and to it the party now made its way; but before reaching the steeper part of the hill, several "finds" were made. Amongst these were caterpillars of the Emperor moth (*Saturnia carpini*), a large moth, with beautifully variegated wings, ornamented with large eye-spots. The caterpillar is bright green, with rows of fascicles of short bristles of a pink colour, and much resembles a sprig of flowering heather. When about to assume the chrysalis state, it spins an egg-shaped cocoon, of which one end is open, but formed of converging bnndles of stiff silk, which permits of egress for the moth, but not of entrance for any enemy. Inside this opening, a small cap of silk forms a further protection. Other captures were larvæ of the Dark Tussock moth (*Dasychira fascelina*), and of the Oak Eggar (*Bombyx quercus*), which makes an egg-shaped cocoon of dark brown silk, and of close texture.

On this part of the hill, as well as in some places near the loch, general admiration was elicited by the luxuriance and beauty of some large patches of heather. Some of these consisted of the Cross-leaved Heath (*Erica tetralix*), the amount of blossom on which surpassed anything that any of the party had seen before, and which, while forming conspicuous objects at a considerable distance, scented the air with their fragrance.

Farragon proper was now reached, and the steep part of the ascent begun. The hill, whose name signifies the wart-like hill (the appropriateness of which must strike every one who has seen it), is very steep and rocky. On reaching the rocks a careful search was made for the alpine plants which might be expected to occur at this altitude (upwards of 2000 feet), but these were found to be few in number. Amongst those that were observed were *Saxifraga stellaris* and *S. hypnoides*, with white flowers; *S. aizoides*, with yellow flowers; and *S. oppositifolia*, with purple flowers; *Thalictrum alpinum*, *Oxyria reniformis*, *Gnaphalium supinum*, &c. Close to the very top of the hill, a patch of the Moonwort Fern (*Botrychium lunaria*) was found.

Having arrived at the top, a little time was spent in admiring the grand view which extended on all sides, embracing the Fifeshire Lomonds, Sidlaws, Ochils, Cairn-

gorm range, Ben Ghloe, Ben Lawers, Schiehallion, and many other hills of less note. In addition to the hills, no less than fourteen lochs were visible, from the larger ones, such as Tay, Rannoch, and Tummel, down to the smaller hill lochans.

Farragon attains an altitude of 2559 feet above sea-level, and being so high, it was with much interest that it was observed that the ice-sheet of the Great Ice Age had overflowed the hill, and left its mark thereon in the form of many "*roches moutonnèes*," which, to the observers standing on the hill, afforded a striking illustration of the immensity of the ice-sheet of that age. Looking at the green and heather-covered hill-sides, it was difficult to imagine that they had at no very distant period (comparatively with their age) been buried deep under a continuous mass of ice, not lying quietly on them, but moving continually in one direction, and by its weight and irresistible pressure hewing out the hills in forms which they retain to the present day.

But time was speeding, and trains, like wind aud tide, do not wait, so a move was made for Aberfeldy, which was reached in due time.

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SEPTEMBER 24th.

4. *To the Dens of Kilspindie, Balmyre, and Pitroddie.*

The excursion was conducted by the President of the Society, Dr Geikie. The day to begin with, though dull, was not unfavourable, and much enjoyable work was done; but the after part proved wet, and interfered materially with the pleasure of the excursionists.

While passing along the foot of Kinnoull Hill, Dr Geikie took occasion to point out the general geological structure of the ground. The lofty cliffs are built up of a series of ancient lava-flows, sometimes separated by thin bands of conglomerate, and resting upon a much thicker bed of the same kind of rock. This lower conglomerate is well seen in the neighbourhood of Kinfauns Castle. Underneath it again comes another series of ancient lava-flows, which are well exposed in Moncreiffe Hill, and the hills behind Inchyra. Thus, in passing from Perth down the Tay to Inchyra, we descend from the top to the bottom of the ancient igneous rocks of the Sidlaw range,—the inclination of the beds being persistently towards north-west. The Tay, in short, has cut its course across a volcanic ridge of Lower Old Red Sandstone age.

Dr Geikie also pointed out the evidences of glacial work in the general features of the ground,—the rocky northern slopes of Moncreiffe Hill being well smoothed and abraded by the ice which came down the Tay valley, and overflowed all the district in a prevalent south-easterly direction: and he indicated the places where glacial striæ and boulder-clay might be seen. The well-marked terraces of sand, gravel, clay, and silt which form so conspicuous a feature in the laudscape, were also commented upon. The highest of these is very fragmentary, but is well developed between Lower Craigie and Friarton. This terrace carries one back to the closing scenes of the Ice Age, and tells of a time when the sea-level stood 100 feet higher than now;—so that the tide then flowed for many miles up into Strathmore. Glaciers then existed in the Highland glens, and much floating ice came down the ancient estuary of the Tay, scattering erratics and debris as it journied towards the open sea. The most conspicuous terrace, however, is that which is traversed by the main road from Perth to Dundee. The average level of this terrace is some 45 feet or so above mean tide. It is composed chiefly of silt and clay, and is evidently of estuarine and marine origin,—sea-shells having been found in it at various places, even as far up as Perth, where oysters were obtained recently during some excavations in the clay at the General Prison. This old terrace is of post-glacial age, and overlies the well-known buried "forest-bed." This latter is best exposed along the banks of the Earn, above and below Bridge of Earn, but it also crops out from underneath the clay at the Friarton. It has yielded remains of oak and Scots fir, together with many reed-like plants and numerous seeds and wing-cases of beetles. Most of the remains of trees seem to have been drifted, but in some places they appear to occupy the place of growth. An ancient canoe, hollowed out of a single trunk of Scots fir, was discovered at the Friarton resting on the "forest-bed." It had been buried under the whole thickness of the Carse-clay. We had evidence, therefore, to show that after the sea had disappeared from the neighbourhood of Perth in late glacial times, our climate became mild and genial, and a thick forest-growth overspread the land. At that time the land seems to have extended further seawards than at present. But the presence of the Carse-clays, which overlie the forest-bed, shows us that the sea again gained upon the land, and the tide again flowed far above Perth,—the sea-level then attaining a height of 45 to 50 feet. While these conditions obtained the climate would appear to have become de-

teriorated, as there is evidence of floating-ice in the Carse-clays, and the clays themselves often closely resemble that fine silt or clay which results from the grinding-action of glaciers. It is probable, indeed, that local glaciers re-appeared in our Highland glens in early post-glacial times, and that the Tay and its affluents carried down in consequence immense quantities of glacial mud, derived from the action of the ice in the mountain-districts. The lower flats of alluvium which border the Tay, at heights varying from a few feet up to two or three yards, show us how, as the sea retreated, the river has gradually worked its way down to lower levels.

Near Glencarse Station a great fault or dislocation of the strata is crossed, although there is nothing of it seen at the actual surface. This great fracture of the earth's crust passes along the foot of Moncreiffe Hill behind the mansion-house, and must cross the Tay somewhere opposite Inchyra. It then strikes in the direction of Glencarse House, and afterwards runs along the foot of the Braes of Gowrie by Kilspindie, Kinnaird, Rossie, &c., on towards Lochee. Another great fault occurs in a similar position at the foot of the Ochil Hills,—the two running approximately parallel. Between these two faults the Upper Old Red Sandstone appears at various places throughout the Carse, as at Clashbennie, Errol, Inchture, and Benvie.

At Kilspindie the party examined the outcrops of ashy conglomerate and porphyrite which are seen at the road-side and in the stream-course, Dr Geikie pointing out that these represent the oldest visible portion of the volcanic series of the Sidlaws. The true igneous nature of the porphyrites was seen in their occasional slaggy and scoriaceous character,—each individual bed being highly cinder-like towards the top, and full of pores and flattened cavities below. Some of these little cavities were filled with calcite, chalcedony, quartz, agate, &c.

At the head of Kilspindie Glen a bed of ash-like conglomerate is visible. This bed, Dr Geikie said, was the lowest of three bands of conglomerate which he had traced all along the Braes of Gowrie. Going towards Perth, however, the three bands appear to come together so as to form one thick mass of conglomerate. It is this same conglomerate which underlies the cliff of Kinnoull Hill.

Crossing the hill between Kilspindie and Pitroddie Den, the party came upon a thick dyke of basalt, which they followed down the hill-slope into Pitroddie Den, where it is quarried on a large scale for causeway stones, for which it is admirably adapted. The quarries show admirably the geological position of the dyke. It runs approximately east and west, is about 50 feet thick, and dips or is inclined at a high angle towards the south. Dr Geikie mentioned that he had seen several dykes of the same character in various parts of the same range of hills,—one of which could be traced from Fingask Den across the wooded hill to the east as far as the turnpike road, on the side of which it had been quarried. The Pitroddie dyke could be followed up to the head of the Den, beyond which its course had not been certainly traced. About half-a-mile or so above the quarry the dyke shows a curious break. It suddenly dies off on the south side of the stream and re-appears on the hill-slope at the opposite side at a considerably higher level. It appears to lie for some part of its course in the line of a "fault" or dislocation.

After examining the thick conglomerate which forms the main portion of Craiglochie Hill, the party proceeded up the Den, where a series of fine sections display a rapid succession of porphyrites and interbedded conglomerates,—the porphyrites being ancient lava-flows, and the conglomerates representing the gravel and stones carried along by torrents and streams. These sections, Dr Geikie said, might be considered as typical. From them we might gather a pretty good notion of the conditions which obtained during the formation of the volcanic series of the Old Red Sandstone formation. The porphyrites had been poured out upon the bed of a great inland sea in such abundance that the later lava-flows were sub-aërial. They formed a long bank or volcanic island, down the slopes of which streams and torrents made their way to the shores of the ancient sea. One could see how the molten rock had now and again overflowed the shingle and gravel carried forward by the torrents, and caught up many of the stones, which we now saw enclosed in the lower portions of the porphyrites.

Colonel Drummond Hay of Seggieden, than whom no one is better acquainted with the Flora of the Carse, acted as botanical guide. It is on the "Braes of the Carse," and in the "dens" which run into the hills, that many of the more interesting plants are to be found. It is true that in the plain some species occur which are not to be found on the braes, but they are for the most part confined to the banks of the river, or of the various "pows" which drain into it. And, considering the high state of cultivation of the Carse, this is not to be wondered at.

Among the more interesting plants which were met with, or their "stations" indicated (the advanced season of the year preventing their being seen *in situ*), may be mentioned the following:—*Mimulus guttatus* (perhaps a variety of the commoner *M. luteus*), a naturalized American plant, at

the foot of the Den of Kilspindie. Near the church, another plant which has long been naturalized in several parts of the Carse, the pretty yellow-flowered *Aremonia agriminoides*, is to be found; while on dry knolls higher up a somewhat local plant, *Cerastium arvense*, is not uncommon. The rough bank near Rait, known as "The Minister's Haugh," is rather rich in local plants, including *Reseda lutea*, a near relative of the well-known mignonette of the garden, but taller and scentless; the pretty red-flowered *Galeopsis ladanum;* the wild carrot (origin of the garden vegetable), *Daucus carota;* and another plant also sometimes cultivated as a pot-herb, the Marjoram, *Origanum vulgare.* Above the haugh the curious fruited Penny Cress (*Thlaspi arvense*), so called from the form of its pods, aud a rare plant in Perthshire, may be found in fields; while on the rocky knolls the beautiful flowers of the Maiden Pink (*Dianthus deltoides*) give a pink glow to the grass. Further on the Agrimony (*Agrimonia eupatoria*), a celebrated plant in ancient times, is abundant; and the rarer Common Comfrey (*Symphytum officinale*) occurs. In the Den of Balmyre some interesting plants were noticed, such as the Wood Geranium (*G. sylvaticum*), which is, however, commoner in some other parts of the county. Here, also, though of course this was not the time of the year to see them, are to be found the three well-marked varieties of the Common Primrose (*Primula vulgaris*). Another interesting but much more local plant occurs here, the Herb Paris (*Paris quadrifolia*), which has generally (though not invariably) all its parts in fours or multiples of four, namely, *four* leaves arranged cross-like at the top of the stem, from the top of which springs the solitary flower with *four* sepals, *four* petals, *eight* stamens, and *four* styles. The flower is greenish in colour, and is succeeded by a bluish black berry divided into *four* cells or compartments, each containing *four* to *eight* seeds. The Beal Hill was next pointed out as the habitat of a plant that is very rare in Perthshire, the Wild Basil (*Calamintha acinos*), a pretty little plant with blue flowers. Here also may be found one of the Butterfly Orchids, *Habenaria albida*, the rarest of the group. Above Evelick Castle, the Petty Whin (*Genista anglica*), a dwarf shrub with beautiful yellow flowers, is abundant. In the Den of Pitroddie and Den of the Godens (which is a continuation of its upper part) several local plants used to grow, though some of them seem now to have disappeared. Amongst those still to be found are the Hemp Agrimony (*Eupatorium cannabinum*), which is not found in more than four or five places in Perthshire; the Hairy Violet (*Viola hirta*); Shining-leaved Geranium (*G. lucidum*); *Carex muricata; Equisetum pratense*, &c.

On arriving at Perth, a halt was made at Tayside, the residence of Mr Robert Pullar, where the party was joined by several members who were unable to be present earlier, and some time was agreeably and profitably spent in examining and discussing the extensive collection of plants that Mr Pullar has brought together. Of the plants which are classed together under the general name of "Alpines," and which to a botanist are amongst the most attractive of cultivated plants, the collection is not yet very extensive, as the rockwork which is being prepared for their reception is not quite completed. Amongst others in the group, two may be especially noticed as having been formerly supposed to be natives of Scotland, namely, *Potentilla tridenta*, and *Tussilago alpina.* These are reputed natives of Forfarshire, where Don is said to have found them; but it is thought that there must have been some mistake, as they have been found by no one else. Other noteworthy plants in this collection are *Penstemon arcticum, Geranium cinereum, Ephilobium latifolium*, &c.

The unfortunate state of the weather, however, compelled the party to concentrate its attention on the brilliant collections in the "winter garden", which, being in every respect "a thing of beauty," must be to its proprietor "a joy for ever," and never perhaps more a joy than when the pleasure is shared by his appreciative friends. To enumerate all that attracted the eye of the botanists, either by beauty of form or colour, or by structure, would take too long; but amongst the numerous climbers which are fast covering the lofty roof may be mentioned *Bouganvillea glabra, Lapageria alba*, and *L. rosea; Lophospermum scandens, Tacsonia van volxemi*, and many other plants with flowers as different in form as in colour. Of other plants that may be noticed is the finest specimen we ever saw of *Begonia ricinifolia*, which is of great size, and one mass of pale pink flowers. Mr Macdonald, the head-gardener, on whom everything reflects the greatest credit, informs us that this plant has been in flower for eight months. Another plant which attracted much attention, and led to some discussion, was a fine specimen of *Musa ensete*, whose immense leaves of a pleasing green contrasted beautifully with the darker and more divided foliage of the palms in its neighbourhood. Passing from the "winter garden" into the "stove," another class of plants compelled admiration; while in the "Erica" and other houses many other beauties were obliged to be too hurriedly passed by, and at last the shades of evening made the party retire from feasting the eye, to recruit, after the labours of the day, at Mr Pullar's hospitable board.

After dinner, Dr GEIKIE, President of the Society, in returning thanks to Mr and Mrs Pullar for their kindness

to the Society, took occasion to allude to the warm interest that Mr Pullar had always shown in the welfare of the Society.

The toast was received with all the honours.

In returning thanks for himself and family, Mr PULLAR said that it gave him very great pleasure to have such a gathering round his table, and he was delighted to see amongst them not only members from the immediate neighbourhood but from a distance.

After a few more toasts, the party broke up.

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## *OPENING OF THE PERTHSHIRE NATURAL HISTORY MUSEUM BUILDING.*

On Saturday, October 1st, at 3 P.M., the Perthshire Natural History Museum building, which has been erected in Tay Street by means of the Moncreiffe Memorial Museum Fund, was opened in presence of a large assemblage of subscribers to the fund, and members of the Perthshire Society of Natural Science. The ceremony took place in the Working Boys' and Girls' Religious Society's Hall,—Dr James Geikie, F.R.S., President of the Perthshire Society of Natural Science, in the chair.

The CHAIRMAN (who was accompanied to the platform by the Lord-Provost and Magistrates, the officers of the Society, and other gentlemen) explained that they had met in the Working Boys' and Girls' Hall because the lecture-room in connection with the Museum could not accommodate the large audience which had assembled, and called upon Dr Buchanan White, F.L.S., the Honorary Secretary, to read a statement by the Committee of the Subscribers.

Dr BUCHANAN WHITE accordingly read a history of the movement to establish a Perthshire Natural History Museum, from its origin up to the present date. He said—On the 28th of February, 1867, the want in Perth of any Society or Association for carrying on the practical study of natural science by "the exhibition and preservation of specimens, the reading of communications, by lectures, excursions, and the formation of a library and museum," led a few enthusiastic working naturalists to found the Perthshire Society of Natural Science. As may be perceived from the words just quoted, which form part of the second law enacted by the new Association at this meeting, the preservation of specimens and the formation of a museum has been from the very beginning a main object of the Society, and with this in view one of the officers was the curator.

At first the Society had no premises of its own, within which specimens or other property could be kept. By the kindness of the Glover Incorporation, the ordinary meetings were held in the Glovers' Hall in George Street; but there were no facilities here for acquiring property, and consequently the Council, in its First Annual Report (March, 1868) alludes to the fact that the Society had been obliged to refuse several offers of specimens, though of opinion that "had the Society a room of sufficient size in which to begin its museum, there would be no lack of donations."

It was not, however, till October, 1869, when it was announced that a room had been secured at Kirkside to serve as "store-room" for the Society's collection; and in the Third Annual Report the members were asked to assist "in getting up a complete museum of the natural products of the county, now that there is accommodation for them."

But these premises were found to be very unsuitable for the purpose for which they had been secured, and so in May, 1870, the Society moved to the rooms in St Ann's Lane, which it continued to occupy up till May last.

After being established in St Ann's Lane, the work of collecting specimens was proceeded with, and cases to hold them were obtained; but as the rooms were small, these were not very extensive, and on this account not so much was done as perhaps might have been accomplished had the facilities been greater.

In 1872, I retired from the Presidentship of the Society, which I had had the honour of holding for five years, and was succeeded by Col. Drummond Hay. Under the new President's rule, the importance of a proper museum was still kept prominently before the Society, for we find from the Sixth Annual Report of the Council that during the past year there had been twenty-four donors to the museum (amongst these was Dr W. C. M'Intosh, of Murthly Asylum, a fact which we commend to the notice of the anonymous writer of the amusing but not strictly veracious history of the Literary and Antiquarian Society which has recently been contributed to one of the local papers).

In 1874 Col. Drummond Hay retired from the Presidentship; and was elected Curator,—Sir Thos. Moncreiffe succeeding to the Presidential Chair. During the following year no great advance was made in relation to the Museum, with the exception that the average number of donations were received.

In the Eighth Annual Report we find the Curator complaining of want of room for museum specimens, but there seems to have been no great inclination to get more cases or to solicit more extensive donations of specimens, till the Society had acquired permanent and more commodious quarters. With this in view, the Council "took into consideration" on Nov. 15, 1875, "the propriety of having larger rooms that might be fitted up as a museum," and inspected a room in the Exchange Buildings in George Street that seemed suitable. Having reported this to the Society, it was agreed to take a lease of the room; but before this was done further consideration of the matter had led to broader views, and at the Tenth Annual Meeting (1876) Sir Thomas Moncreiffe reviewed the whole matter of the Society's museum, pointing out the difficulties that lay in the way of depositing valuable specimens in the rooms occupied by the Society, and mentioning a site which might be secured for a suitable Museum. It was not, however, till March, 1877, that Sir Thomas, still President of the Society, in his presidential address, brought forward the scheme which has resulted not only in the building which we are now gathered to open, but in that large and commodious Public Hall further up the street of which Perth may well be proud. The President's address and the discussion which followed extend to too great length to be repeated here, but the essence of it is that the Society should not aim at any small or selfish scheme, but consider seriously the desirability of having a thoroughly practical educational Natural History Museum, which should only be the nucleus of a future science school; and that in proximity to the museum should be a large Public Hall, the erection of which, though advocated by the Society, should be left to the community or a Limited Company. The proximity of the large hall to the Museum buildings would make the former available for lectures, conversaziones, or other meetings, for which the lecture-room of the Museum would be too small, and yet which for many reasons it would be desirable to have close to the Museum. In a word, the scheme was one of these broad, enlightened, and large-hearted ones sure to recommend itself to every unbiassed mind, to whom the good of the community and not of self was an object.

The doings of the succeeding year are admirably summed up in the President's (Sir Thomas Moncreiffe) address at the Eleventh Annual Meeting, and, in view of the many false statements which have recently been so industriously circulated, we are very much tempted to make some lengthy quotations from that address, showing the "kind" and "generous" way in which we have been treated by the Literary and Antiquarian Society. But (as will be presently mentioned) the public were afforded an opportunity of giving a decision on the merits of the rival schemes, and as in face of this the Antiquarian Society has persisted in going on with its publicly-condemned scheme, it would perhaps be but loss of time to do so; and the misstatements to which we have alluded are best treated with the silent contempt which is all they deserve.

As the outcome of the various meetings, it was resolved by our Museum Committee on 4th April, 1878, to take steps to raise funds to carry out the scheme of a Museum building in Tay Street, and towards it Mr Robert Pullar subscribed £500 (conditional on a certain amount being raised); Sir Thomas Moncreiffe promised £100; and £100 had been promised by Sir W. Stirling Maxwell shortly before his unexpected death.

Here the matter rested for a little while. Trade was bad, and money not abundant; and while no very active steps were taken to promote the scheme, still it was never lost sight of, but was being steadily matured.

It would have been naturally supposed that the resolution come to by the Museum Committee in April, 1878, would have ended all negotiations with the Literary and Antiquarian Society, but by a proposal which emanated from that Society, it was resolved to submit the whole question to a Representative Committee of the public for its decision. The meeting in question took place on April 26th, 1879,—Lord-Provost Richardson being chairman,—with the result of showing that public opinion was entirely in favour of the views advocated by our Society. But the other Society refused to be bound by the decision of the Committee to which it had appealed, and so far as we are concerned, that Society does not again appear on the scene.

In August of that year our Society received a very severe blow in the lamented death of its large-hearted President; and had not the way been prepared by the untiring industry and ever-ready tact with which he had for several years advocated the scheme of a Museum, it is but too probable that we would not to-day have been assembled for the purpose for which we are met. The enthusiastic earnestness with which, during the last few years of his life, Sir Thomas Moncreiffe had advocated his Museum scheme, was not, however, destined to be lost. Those who had had the privilege of working with him were in fact the more anxious to do honour to his memory by at once carrying out his plans, and justly deemed that his most appropriate memorial would be the

raising of a fund to carry out his cherished idea. With this object a large and influential Committee was appointed, a canvass for subscriptions organised (Mr Robert Pullar renewing his munificent offer), plans prepared, and a site secured.

To return for a moment to the Society (for it must be remembered that the Museum Committee, though naturally composed for the whole, or most part, of members, is yet a body outside the Society). Dr Geikie, F.R.S., succeeded Sir Thomas Moncreiffe in the presidency, and almost as a matter of course devoted his first official address to the subject so immediately before the members; and sketched from his large experience the lines on which the arrangement of a local Museum should be planned. At the same meeting, our Curator, Colonel Drummond Hay, had the satisfaction of announcing that, in consequence of the prospect of a proper building being provided, very numerous and valuable donations illustrative of the Natural History of Perthshire, had been promised. We need not detain you with an account of the details of the subscription-list, which I now lay on the table. It will be sufficient to say that the total amount of the subscriptions promised up to the present date amount to nearly £1800—(more exactly £1787); and that the contracts for erecting the building (which do not, however, include painting, nor a variety of other incidental expenses) amount to about £1720. To meet the excess of expenditure over receipts, the Committee venture to hope that some additional subscriptions may yet be forthcoming. In conclusion, it may be mentioned that the buildings have been vested, for behoof of the Perthshire Society of Natural Science, in the following trustees:—Andrews Coates, Esq.; Colonel Drummond Hay of Seggieden; Magnus Jackson, Esq.; John M'Gregor, Esq.; Robert Pullar, Esq.; Horace Skeete, Esq.; F. Buchanan White, Esq., M.D., F.L.S.; Colonel Williamson of Lawers; C. L. Wood, Esq. of Freeland; and John Young, Esq., C.E.

Mr Robert Pullar next addressed the meeting. He said—An important and pleasant duty has been deputed to me to perform on this occasion, viz., the handing over of the title-deeds of the Natural History Museum Buildings to the trustees of the Institution. May I be permitted for a few minutes to refer to the various parts of the building:—I. The Lecture-Room. This I consider a most important part of the institution. A local Society should not exist merely or mainly for the formation of a museum. A museum can be formed (and many of the best are) without the assistance of any Society. Therefore, a Society which exists merely as an adjunct to a museum is not worthy of the name. As a supplement to the lecture-room, the laboratory, and library, a museum is most useful. Demonstration, experiment, and discussion are the real means of teaching; so the lecture-room of our Society has ever been the centre of our working, and in the improved accommodation all the other rooms will cluster around this, and I trust much good work may be done. I am happy to say that the lecture-room is not to be used exclusively by our own Society. We have already given the use of it to a Literary Society in town, and I am sure the Council will always be desirous to give accommodation of this kind to other Societies, when the room is disengaged.

II. Laboratory or Workroom. This was much needed, and here members will have an opportunity for exercising the practical study of natural science. The necessary implements and apparatus for the investigation of the structure, anatomy, and composition of plants, animals, minerals, &c., will be provided; and experienced members of the Society will give instruction and assistance as required. Some may say this work could as well be done by members at their own houses, but in the laboratory they will find not only necessary implements and books, but also an opportunity of undisturbed study, as well as meeting with those who are engaged in similar pursuits; and, further, after the outdoor excursions, every appliance will be found here for preserving specimens for the Museum, and instructions will be given in the best methods of preserving and mounting specimens.

III. The Library is contiguous to the workroom, and is to be furnished with books of reference, scientific magazines and journals, and writing tables, for the use of members studying or preparing papers or lectures. I need scarcely say the Secretary will most thankfully receive donations of scientific books or journals.

IV. The Museum is a room admirably suited for its purpose, and it is intended ere long to be filled with an interesting and instructive collection of Perthshire objects, where our citizens may learn what their own neighbourhood produces. The highest authorities say that the proper work of a local Society is the study of the local natural history, and that a local museum ought chiefly to be devoted to this. The promoters of the Perthshire Society of Natural Science have kept steadily before them hitherto this idea, and mean to do so more and more in their new and commodious premises.

In addition to the museum accommodation at present provided, a large space of ground remains unoccupied behind the Museum buildings, where, if necessary, two or more large halls could be built. At present it is proposed

to utilise this ground by devoting it to growing some of the more rare and notable Perthshire plants as illustrations for students. I consider that if the Perthshire Society of Natural Science continues in the way it has gone, and does work in proportion to what it has already accomplished during the past years with so many drawbacks of deficient accommodation, that the subscribers will have no cause to regret having provided the handsome and commodious building now erected.

I believe I speak the mind of all the members of this Society when I say we deeply regret the strong and unjustifiable language that has been used by an individual connected with another Society, in which he labours to show that we were the great means of preventing co-operation or harmony of working between the Literary and Antiquarian Society and ourselves. I indignantly deny the statements made by that anonymous writer, and feel assured that the "history" he professes to write will not improve the position of his Society in public respect or support. I think our excellent secretary, Dr F. Buchanan White, has more wisely expended his literary powers in editing the *Scottish Naturalist*, the journal of our Society, which is now well known in scientific circles at home and abroad. Our Society has always most cordially welcomed co-workers of other Societies, believing there are ample fields of study and research for all, whether their tastes lead them to antiquarian or to modern, to literary or to scientific, investigations. Certainly, our Society has no reason to feel envious or jealous of the Literary and Antiquarian Society. They go their way and we go ours, and there is room enough for both. We as a Society have not sought out such an array of brilliant British and foreign savans as have good-naturedly given their names to adorn the advertisement of the Literary and Antiquarian Society. We did not think it right to spend our contributors' money in this way;—neither would our respected President care to be described as "fitly representing all that is noble, cultured, and sage in the county and city." We do not deal in such well-rounded periods, but prefer to do some good useful work, as we have hitherto done; and no one will deny that there is also room for the Literary and Antiquarian Society doing much more work in the future than it has done in the past.

Our Society much deplores the death of our late President, Sir Thomas Moncreiffe. To him this day would have been a proud and happy one, for it was ever his earnest desire to see the Society in a proper local habitation. No more fitting memorial could be erected to one who had the interests of science so much at heart, and the members can best honour the memory of our late President by making full use of the premises now provided, and by diligently studying those sciences he loved so well. I have much pleasure, Mr Chairman, in handing to you, in name of the subscribers, the title-deeds of this building.

In replying, Dr Geikie said—It is with no little gratification that, on the part of the Perthshire Society of Natural Science, I accept from the subscribers to the Moncreiffe Memorial Museum-Fund the title-deeds of the handsome and admirably-arranged building. I am sure that I speak the sentiments of every member of the Society when I say that we are deeply grateful for the kind consideration shewn towards us by making us the custodians of this most welcome benefaction. We are happy to think that the scheme originated by our late highly-esteemed President has been so soon realized, and that our friends and wellwishers have succeeded in their unselfish efforts to provide means for the better prosecution of natural science studies in this community. The completion and appointment of this building is the best memorial of our late lamented friend, Sir Thomas Moncreiffe, which could have been devised. It was a scheme which, as you know, he did all in his power to further, and we most sincerely regret that he was not spared to see it carried to a successful conclusion.

Provided as we now are with a building of our own,—with rooms well suited for work, for meetings and lectures, and for museum purposes,—there ought to be a long course of prosperity before us. It will, indeed, be largely our own fault if we do not succeed by and by in making our institution a perfect model of its kind. We are still a young Society, with all the vitality and all the promise of healthy youth; and if we have not been born with a gold spoon in our mouth, we have at all events been presented with one now, which is more than many Societies of advanced years can boast.

I look upon the possession of a building by a Society like ours as of paramount importance. It gives it as it were a personality and stability; it puts fresh life into the members, and acts as a loadstone, drawing the attention of the public to the work done, and thus at the same time attracting many to join in the work, and so to aid in the advance of knowledge. I hope and believe it will be so with us, and that the building which is formally opened to-day may ere long prove too small for the growing educational requirements of this town and county. By the wise prevision of our friends, however, sufficient space behind has been reserved, upon which such additional buildings may be raised, as may from time to time be required.

You may sometimes hear it said that institutions like ours

are of little importance,—that at the best they afford harmless occupation or pastime for leisure hours. Well, ladies and gentlemen, even if this were all it would yet be a sufficient reason for their existence. But you shall find, that those who pooh-pooh our work in this way, are hardly the people who are qualified, either by natural intelligence or a liberal education, to express any opinion on the subject. They move smoothly enough, it may be in a little orbit which satisfies all their aspirations, but they need not feel surprised if to others it should appear that there is more in heaven and earth than is dreamt of in their philosophy. Ask any thinking man what it is that distinguishes our times above all the ages that have passed away, and he will tell you it is the spirit of scientific inquiry,—it is the great advance made in conquering and rendering subservient to our will the mighty forces of Nature. In no other respect are we in advance of our predecessors. Nay, in many departments of human attainment we lag far behind them. In literature, art, and philosophy we have doubtless great names,—names which will probably go down to a very remote posterity; but none of these can equal the greater lights of earlier centuries. Homer and Æschylus, Virgil and Horace, Dante, Chaucer, Shakespeare, Milton, and many other stars of song, are still unequalled as lights of the first magnitude. The architecture and sculpture of ancient Greece are at once our envy and despair; and what painter of modern days can place his canvas on a line with the splendid efforts of a Michael Angelo, a Titian, a Raphael, or a Murillo? Among our recent philosophers, what name dare we put on a level with Plato? not to mention any of the intellectual giants of later times. Does not most of our recent work in philosophy consist chiefly of criticisms and reviews,—or of more or less feeble reproductions of speculations and theories which greater minds evolved centuries ago? Or, if there be anything original and of lasting value in it, does not it draw its inspiration directly from the results obtained by the study of natural and physical science?

If we wish, then, to live up to the spirit of the present age, surely we ought to take an intelligent interest in science. It is our privilege not less than our duty to do so. I might even go further, and say that those to whom scientific studies are merely an idle pastime might just as well have been living in the Middle Ages. They are a kind of fossils, representative of conditions which have passed away. To understand and appreciate the many great problems which are engaging the attention of the more active minds in our day, some knowledge of science and scientific modes of thought is indispensable. Were a practical acquaintance with some science or another more general, we should be less subject to those ignorant fears and foolish panics which every fresh advance of scientific thought would seem to give rise to, as if the fonndations of morality and religion were in danger. Again, were the limits of inquiry in the physical and natural sciences better understood, we should be able to estimate at their proper value the speculative opinions of theorists who, professing to base their views on the evidence of those sciences, yet venture into regions where observation and experiment are alike impossible, and imagine they can discover all the secrets of the unknowable with a rush-light, and measure the infinite with a foot-rule.

It is not without solid grounds, therefore, that we claim for such studies as ours a high and important place in any curriculum of education. Animated as we are—and, I hope, will continue to be—with the earnest desire to foster the study of science in this neighbourhood, we may anticipate the time when this institution will greatly outgrow its present limits. We would look upon it as only the nucleus of what may yet be an important school of science—physical not less than natural.

On the present occasion, however, I would rather speak of the certainties of to-day than try to picture forth the probabilities of to-morrow,—believing, as I do, that if the work which we now find ready to our hands be done honestly and faithfully, the future will be all, and more than all, we can anticipate.

The founders of the Perthshire Society of Natural Science were wise, I think, in deciding that the Society should be available to all, for which purpose they fixed a low annual subscription. And the same spirit has continued to animate the various Councils which have successively administered the affairs of the Society. Their desire has always been to make the Society as open as possible, and not an exclusive institntion for the benefit of the few. The annual subscription, I may remind you, is only 5s, upon the payment of which any one may become a member, and share in all the privileges of the Society, whether he be a student of natural science or only a well-wisher of such studies, and desirous of aiding the Society in its work. But this is not all. Small as is this annual subscription, there are still some to whom it is prohibitive, and to meet the case of such we instituted another class, called *Associate-members*, who pay only half-a-crown annually. These associates, however, must be naturalists. There is yet another class of associates, who must be naturalists, and help the Society in some form or another, but who pay nothing. Although we have nearly 200 members on our roll, yet, considering

the lowness of the subscriptions, it is extremely desirable that the membership should be largely increased, to enable us to utilise our new building in a thorough manner, and to keep the museum open without charge. And I take this opportunity of again appealing to the community on our behalf. We would fain enroll as members every student of natural science in our neighbourhood,—every one who desires either to study or to help on others in their studies. Some of our most esteemed members make no pretensions to scientific knowledge, but they evince their interest in our work by attending our meetings and lectures, and by accompanying us in our summer and autumn excursions. Their presence is a great encouragement to us; and from the interest they take in our proceedings, we might infer, even if they had not assured us, that our friendly communion is mutually advantageous. I hope that the number of such friends will continue to increase, which in so large a community as this cannot surely be too much to expect. Need I remind you also that ours is a gallant Society. Some years ago we resolved to admit lady-members, and the result surpassed our expectations. Our lady friends now constitute a fair proportion of our number, and they have not been content to be only ornamental members. Among them are some most assiduous workers; and of those who braved the discomforts of our former room in St Anne's Lane with most persistent courage, a good many were ladies.

I make my appeal again to the many young people of the rising generation, to whom a working knowledge of natural science would be of inestimable value. Those who have never turned their attention to such studies do not kuow the pleasure, I would even say the delight, which they engender. To acquire an intelligent knowledge of the fair world in which we live, and of the great operations of nature which, under the guidance of infinite wisdom, are continually modifying not only the solid crust of our globe, but every living thing that surrounds us, is surely a worthy object of ambition, and one which must of necessity have an ennobling influence upon our life. To inquirers after such knowledge we offer the heartiest welcome. They will find in the association of fellow-workers which our Society offers the best incentive and encouragement to study. I need not, however, dwell at present upon these, and other matters connected with the Society. Another opportunity will doubtless offer itself ere long. There is just one subject upon which I wish to say a word or two. You are aware that we purpose to have a bazaar by-and-by, to aid us in startiug free of debt, and, if possible, to provide us with a small endowment to meet the cost of maintaining our new building. And, in passing, I may mention that our bazaar will have special scenic effects, not hitherto seen at any bazaar in Scotland. Our friends will not confound our bazaar with that which our neighbours of the Literary and Antiquarian Society intend to open next week,—and which, I hope, will be successful, for in a city like Perth there ought certainly to be ample room and plenty of work for a Literary and Antiquarian Society. It is to be regretted, however, that the two bazaars should fall in one and the same year; and we could have wished that the Literary and Antiquarian Society, who have delayed moving in the matter of additional museum accommodation for so long a period, should have postponed theirs for another twelvemonths; more especially as our intention to open one in the course of the present year had been duly made public for some time before any intimation of their's appeared. We are so circumstanced that we cannot postpone ours indefinitely;—it is essential, now that our building is completed, that our long-advertised bazaar should be opened this year, upon as early a date as possible. But to obviate as far as possible the inconvenience likely to arise from having the two within a few weeks or days of each other, we resolved to change the date of ours from September to December—a piece of considerate good feeling on our part which was no doubt grateful to our Literary and Antiquarian neighbours, who have now a fair field in which to reap. In doing as we did, however, we made a considerable sacrifice, but we feel confident that the public will appreciate our action in this matter, and will not be the less ready to patronise our fancy-fair at Christmas time. At all events they are not likely to be influenced by the misrepresentations of which we have been the uncomplaining victims for some time past. It is perfectly well known that the scheme which we have so far successfully carried out—thanks to the efforts of our many friends—has all along had the emphatic approval of the public. Knowing and thankfully acknowledging that fact, we can afford to treat with perfect equanimity and indifference any degree and amount of misrepresentation which it may please unwise people to indulge in.

No one regrets more than I do that any unpleasant feeling should have arisen between the two local Societies. There is no reason in the world why they should not work in harmony; and, notwithstanding what has passed, I feel convinced that good sense will by and by prevail, and a cordial co-operation be established. That this would tend to the best interests of both no one can doubt. And as an earnest that such co-operation may come about at

no distant date, I may mention the gratifying fact, that the two Societies are likely to unite with similar societies in Dundee and several other towns in obtaining the services of science-lecturers, to be provided by the Gilchrist Fund. In a recent address to this Society, you may remember that I mentioned that we were co-operating with the Dundee Naturalists' Society to obtain the advantage of this fund, and I am now happy to state that these negotiations are likely to be crowned with success. I cannot but congratulate the members of this Society that they are now in a position to take full advantage of this and similar means of instruction. It is our intention ere long to make the attempt to establish regular classes for the teaching of natural science; and our building will always be at the service of those who may desire the use of our rooms for similar purposes. Already we have had an application from the Ladies' Educational Association for the use of our lecture-room—a request which I need hardly say we have much pleasure in granting.

Now, ladies and gentlemen, I need not detain you longer with any remarks of mine. I will only ask you to join with me in tendering a very hearty vote of thanks to the subscribers to the Museum Fund. And with this vote of thanks, I would couple the name of Col. Drummond Hay, who, all through a somewhat trying time, has been one of our best friends. I trust that he and the other subscribers who have so unselfishly come forward to help us may live to see this building, which is their gift, become every year of increasing importance,—fostering the love of science in our midst,—spreading abroad a truer because more intelligent appreciation of the beautiful creation of which we form a part,—and leading many to see that a reverent and humble study of nature, so far from having any materializing effect, must tend more and more to elevate our conceptions of the wisdom and beneficence of the Divine Creator and Upholder, in whom we live and move and have our being.

Colonel DRUMMOND HAY, in replying, said that he was sure that all those in the room who were naturalists, and who had the pleasure of listening to the instructions of the President of the Society, would do what they could to support him in carrying out the good objects which he had tried in every way to bring before the Society. He thought the Society was exceptionally fortunate in having for its President one who occupied the position that Dr Geikie did.

Sheriff BARCLAY proposed a vote of thanks to the Committee who had wrought so laboriously to perfect the Museum Scheme. He belonged to both the Natural Science and Literary and Antiquarian Societies, and he would like all the ladies and gentlemen present to be members of each of these Societies also. In conclusion he expressed much pleasure in proposing a vote of thanks to the Committee who had laboured so industriously to get erected the Museum building, which was worthy the Society and worthy the memory of that great man, Sir Thomas Moncreiffe.

Dr GEIKIE proposed a hearty vote of thanks to the directors of the Working Boys' and Girls' Religious Society for their kindness in granting the use of the hall.

Sir ALEXANDER MUIR MACKENZIE proposed a cordial vote of thanks to the President of the Society for his conduct in the chair. In his address he had combined amusement with instruction, and anticipating what had been urged upon them by their excellent friend, Sheriff Barclay, had provoked somebody,—and, he hoped, to good deeds.

The company then broke up, and, having inspected the Museum buildings, were served with tea in the Museum Hall.

# PROCEEDINGS

OF THE

# Perthshire Society of Natural Science,

WITH

## LIST OF MEMBERS.

VOLUME I. PART II.

1881–82.



PERTH:
PUBLISHED BY THE SOCIETY AT THE
PERTHSHIRE NATURAL HISTORY MUSEUM.

MDCCCLXXXII.

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# SESSION 1881-82.

NOVEMBER 24th, 1881.

JAMES GEIKIE, Esq., LL.D., F.R.S., President, in the Chair.

NEW MEMBERS.

THE following were nominated for election as members:—Dr Simpson; the Rev. Mr Dickie; the Rev. Mr Dodd; Mr D. Galloway, Vinebank, Kinnoull; Mr Paul Darling, Elcho; Mr George Pitcaithly and Miss Pitcaithly, Elcho; Mr James Gaudie, Postal Telegraph Office; Mr John G. Millais, Marlborough; Mr Hugh Crawford, Moneydie; the Rev. John Ferguson, Aberdalgie; the Rev. Canon Hodson, South Methven Street; Mr James Milne, M.A., teacher, Dunkeld; Mr J. Scott, General Prison; Mr Alexander Jamieson, Barossa Place; Mr James Stewart, L.D.S., Princes Street; Mr James Sime, 292 High Street; Mr James Fenton, Burnside, Craigie; Mr William Bruce Gowans, St Leonard Bank; Mr Charles S. Whittet, Barossa Place; the Rev. Andrew Benvie, Scone; Mr James Brebner, Dundee; and Mr Alexander Westwood, Princes Street.

Dr BUCHANAN WHITE exhibited the following:—1. Specimens of cones of the common larch, sent by Mr C. Macintosh, Inver. These specimens shewed what was termed prolification of the inflorescence, and were of value as proving that the cone was a modified branch, and the scales modified leaves. This monstrosity is not of rare occurrence. 2. Specimens of a fungus, *Corticium amorphum*, which he discovered, for the first time in Britain, on Kinnoull Hill, a few years ago. It grows on dead branches of silver fir. The specimen shown was the finest that had been yet found. He explained the microscopic structure, which was very remarkable. 3. Specimen of another fungus, *Corticium comedens*, not uncommon on dead branches. The structure of it was also described.

Dr BUCHANAN WHITE presented to the Society a peculiar piece of rock, which had been found in the quarry at Barnhill, and asked the chairman to describe it.

The CHAIRMAN explained that the rock was composed chiefly of carbonate of lime, with pieces of volcanic rock scattered through it, and had been formed in the crack of a rock by water depositing carbonate of lime.

Mr JOHN YOUNG presented a fine specimen of *Lepidodendron.*

Mr MAGNUS JACKSON presented the Society with a framed photograph of the members, taken at one of the excursion parties.

There were a large number of other donations (zoological, botanical, and geological), but notice of them was reserved for a future occasion, when they will be laid on the table.

"PROCEEDINGS."

Volume I.—Part I. of the "Proceedings" of the Society was laid on the table.

THE ANNUAL DINNER.

It was announced that the annual dinner would take place on December 16th.

The following papers were read:—

1. "*The Annals of the Society from its Foundation to the Present Time.*" By Dr Buchanan White, F.L.S.

When in 1867 a few students and lovers of natural history met in a back room in Charlotte Street and founded the Perthshire Society of Natural Science, there was none bold enough to prophesy that in less than fifteen years the Society would meet in a handsome and commodious building of its own. That such might come about after very many years had passed away was perhaps contemplated by the most sanguine of the founders, but even his ambition could scarcely anticipate the event which ought to make this meeting ever memorable in the history of the Society. It seems, therefore, but fitting that part of this the first meeting in our new home should be devoted to a review of the past, whereby we may not only see in what points we have been successful in carrying out the objects of the Society, but, what is more important, discover in what matters, and how, we have failed. Thus shall the shortcomings of the past conduce to the successes of the future.

The Society was founded on the 28th of February, 1867, by fifteen gentlemen desirous of promoting in Perth the practical study of natural history "by the exhibition and preservation of specimens, the reading of communications, by lectures, excursions, and the formation of a Library and Museum." How far

they and their successors have been successful in carrying out this programme may be learnt in part from the following epitome of the chief events of each year of the Society's existence.

FIRST YEAR (1867–68).

President—Dr Buchanan White; Secretary—Mr John Stewart; Treasurer—Mr John Bruce.

During this year the Society met in the Glovers' Hall, George Street. Twelve meetings were held, at which fifteen papers were read. Two excursions were made.

SECOND YEAR (1868–1869).

President, Secretary, and Treasurer—the same as during the first year.

Eleven meetings were held in the Glovers' Hall, and eleven papers read. Six excursions were made.

THIRD YEAR (1869–70).

President—Dr Buchanan White; Secretary—Mr James M'Farlane; Treasurer—Mr John Henderson.

The meetings (thirteen in number) were still held in the Glovers' Hall, and seventeen papers read. No excursions were made during this year, but two very successful scientific conversaziones were given in the City-Hall. During this year also a room was secured in Kirkside to serve as a library and store-room.

FOURTH YEAR (1870–71).

President—Dr Buchanan White; Secretary—Mr A. T. Scott; Treasurer—Mr James Henderson.

During this year the Society transferred its meetings to the rooms in St Ann's Lane, which it continued to occupy till May, 1881. Ten meetings were held, and several excursions made. Eighteen papers read.

FIFTH YEAR (1871–72).

President—Dr Buchanan White; Secretary—Mr A. T. Scott; Treasurer—Mr Robert Thomson.

Nine ordinary meetings were held, at which fifteen papers were read. During this year a beginning was made of the publication of a "Fauna Perthensis;" and the Society's journal —"The Scottish Naturalist"—was founded. Of the magazine more will be said presently.

SIXTH YEAR (1872–73).

President—Colonel Drummond Hay; Secretary—Dr Buchanan White; Treasurer—Mr Robert Keay.

Seven ordinary meetings were held, at which fourteen papers were read. Three excursions were made. In March, 1872, a meeting "to test the quality as articles of food of certain Perthshire animals" was held, and was very successful, though I am not aware that the animals thus tested (squirrel, frog, and several species of snails) have on that account become ordinary articles of food in the county.

SEVENTH YEAR (1873–74).

President—Colonel Drummond Hay; Secretary—Dr Buchanan White; Treasurer—Mr Melville Jameson, jun.

Seven meetings were held, at which eight papers were read.

EIGHTH YEAR (1874–75).

President—Sir Thomas Moncreiffe, Bart.; Secretary—Mr John Young; Treasurer—Mr Melville Jameson, jun.

Seven meetings were held, at which nine papers were read. Seven excursions were made during the summer months. In this session it was arranged that the ordinary monthly meetings should be held alternately in the evening and the afternoon. A new officer, with the title of Editor, was added to the Executive of the Society.

NINTH YEAR (1875–76).

President—Sir Thomas Moncreiffe, Bart.; Secretary—Mr John Young; Treasurer—Mr James Duncan.

Seven meetings were held, at which nine papers were read. Six excursions were made.

The increasing prosperity of the Society suggested the advisability of more commodious premises being obtained, and attempts were made to obtain such, but without success.

Several important events occurred during this session. Amongst others was the communication of a paper to the Society by (the late) Dr Lauder Lindsay, the result of which was to bring about a considerable extension of the water-supply of Perth. Another was the meeting in Perth, under the auspices of the Society, of the Cryptogamic Society of Scotland. This Society has subsequently had meetings in Edinburgh, Glasgow, and other places, but in none have the meetings been more successful than the one in which our Society assisted.

TENTH YEAR (1876–77.)

President—Sir Thomas Moncreiffe, Bart.; Secretary—Mr J. Young; Treasurer—Mr James Duncan.

Four monthly meetings were held, at which four papers were read. Four excursions were made. Other monthly meetings and excursions had been arranged, but owing to adverse circumstances were not held.

During this session the subject of proper accommodation for the Society, more especially with the view of carrying out the scheme of a local Natural History Museum, was brought prominently under the notice of the members by the President. In connection with this he advocated the building of a good Public Hall, not to be undertaken by the Society, but by the community, or by a Limited Company. The result of this has been the erection of the handsome New Public Hall in this neighbourhood, as well as, what more immediately concerns us, the excellent building in which we are now met.

ELEVENTH YEAR (1877–78.)

President—Sir Thomas Moncreiffe, Bart.;—Secretary—Mr J. Young; Treasurer—Mr J. M'Gregor.

Six monthly meetings were held, at which five papers were read. Three excursions were made. Durng this year an alteration in the rules was made by which ladies were admitted to the privileges of the Society.

A further advance was made in the development of the Museum Scheme brought forward during the previous session.

TWELFTH YEAR (1878–79.)

President—Sir Thomas Moncreiffe, Bart.; Secretary, Mr T. Young; Treasurer—Mr John M'Gregor.

Seven monthly meetings were held, at which seven papers were read. Three excursions were made. In addition to the monthly meetings, a course of lectures was arranged and carried out.

THIRTEENTH YEAR (1879-80.)

President—Sir Thomas Moncreiffe, Bart.; Secretary—Mr J. Young; Treasurer—Mr J. M'Gregor.

Five monthly meetings were held, at which eight papers were read. Four excursions were arranged, but owing to inclement weather only two were carried out.

In August, 1879, the Society had the great misfortune to lose by death its President, than whom no member had more at heart the true interests of the Society, or had done more—both by example and precept—to promote its objects. To him is due the elaboration of the Museum Scheme which has resulted in the noble building in which we are now assembled, and with which his memory will ever be associated.

FOURTEENTH YEAR (1880-81.)

President—Dr James Geikie, F.R.S.; Secretary—Mr J. Young; Treasurer—Mr J. M'Gregor.

Seven monthly meetings were held, at which eleven papers were read. Four excursions were made.

FIFTEENTH YEAR (AS YET UNCOMPLETED.)

President—Dr James Geikie, F.R.S.; Secretary—Mr J. Young; Treasurer—Mr J. M'Gregor.

Only two meetings of this session have been held, at which three papers were read. Four excursions were made. During this year the first part of a volume of "Proceedings" of the Society was printed, and the year will be, moreover, ever memorable as that in which the Society entered into possession of its new building.

From the statistics given above, it will be seen that, in the fourteen and one-half years of its existence, the Society has held (in addition to many Committee and other meetings), 114 ordinary monthly meetings, at which 169 papers (including 15 Presidential addresses), have been read. It has, moreover, given two very successful conversaziones; superintended various lectures; and for the instruction of its members in field work made 57 excursions, of which some record has been kept; as well as many other shorter excursions of which no mention is made in the minute-book. Amongst the latter were two series of open-air botanical demonstrations, which seem to have been much appreciated at the time.

But the Society has not restricted itself to work of the kind just mentioned. It has during the past fourteen years brought out several publications, and taken in hand several others which are not yet completed.

The first of its publications was the inaugural address delivered by the President at the first meeting, which was followed in little more than a year by a small volume of "Proceedings," a continuation of which was, however, abandoned in favour of its quarterly journal,—the *Scottish Naturalist,*—the first number of which appeared in January, 1871. A few particulars regarding the progress of this magazine may prove interesting. Since its foundation a number has appeare regularly every three months, so that the forty-fourth has now been reached, making altogether five and a-half volumes, containing upwards of 2000 pages, and nearly 650 articles, which for the most part bear upon the Natural History of Scotland. After retaining the publication in its own hands till the end of 1877, the Society made it over in 1878 to Messrs Blackwood & Sons, the conducting of it remaining, however, in charge of the Editor of our Society. That the *Scottish Natnralist* has far surpassed the most sanguine expectations of its founders need scarcely be said. It would hardly become me to launch forth in its praises, but, judging from the unsolicited offers to take it, in exchange for their own publications, made by a number of Societies, &c., in this country, on the Continent of Europe, and in North America, it seems not to be altogether unappreciated. But, like all magazines of a similar kind, its progress has not been one unattended with difficulty. Like them, the ranks both of its subscribers and contributors are not unlimited, and it may be that some day, from lack of one or the other, its career may be cut short. How many subscribers there may be to it in our Society I am unable to say, but I have little doubt but that there *might* be many more, and, considering its origin and the low price, may say that there *ought* to be many more.

Another publication of the Society was the first part of a catalogue of the animals of Perthshire, which, under the title of the "Fauna Perthensis," appeared in 1871, in the form of a *catalogue raisonee* of the Perthshire Lepidoptera. This met with a favourable reception, and has long been out of print.

Passing over several reprints of papers which first appeared in the *Scottish Naturalist,* and were afterwards published by the Society, we come to the latest venture, "The Proceedings of the Perthshire Society of Natural Science," of which Volume I.—Part I. is published to-day. I say "venture," for it depends on its reception by the members if the publication of it is to be continued. Apart from the papers which, after having been communicated to the Society, have appeared in the *Scottish Naturalist,* no record of the meetings of the Society (with the exception of occasional Annual Reports) have been made in permanent form, and it was thought that the members might like to preserve an account of the meetings and of the excursions, if such could be provided for them at no great expense. Should a sufficient number of members purchase copies of the part now published, your Council will be encouraged to continue it in future years; but unless such is the case, it must be abandoned, as the possession of their new buildings will bring with it an increased annual expenditure to the Society. It might be worthy of consideration whether it is not desirable that a very few pence should be added to the annual subscription, and a copy of the "Proceedings" sent to each member as a matter of course.

Having now sketched the history of the Society from its foundation up to the present time, we may advantageously devote a few minutes to a consideration of the lessons to be derived from our experience of the past, and allude to a few points in which improvement seems to be needed.

Of these the most important is that relating to "papers" and

communications. In almost all Societies the active labourers—those who carry on the actual work of the Society—bear comparatively a small proportion to the total number of members, and our Society does not present any exception to this rule. In fact, if the truth must be made known,—and on an occasion like this it is very desirable that we should consider our position in all its aspects,—the workers in our Society are at present a smaller proportion than should be the case. In some periods of the past this was not so; and I trust, and in fact have little doubt, that in the future it will not be so either. But in the meantime it is the case, and we ought to discover, if possible, "the reason why." One or two apparent causes occur to me, and of these the chief seems to be the nature or style of "papers" into which we have drifted of late years. I do not for a moment wish to insinuate that these papers are in any way unworthy of the Society. On the contrary, many of them have been most excellent, and very highly appreciated; but this very excellence has possibly been the cause why we have not had more of them, and by more numerous authors. There are comparatively a number of members, qualified in every way to favour us with communications, who never, or very rarely, make an appearance on our rostrum, and I think it is only diffidence on their part which prevents them coming forward. This is not as it should be. We are all students,—we have all a great, a very great, deal to learn,—and will have to the end of the chapter; and any note or communication, however trivial or however familiar it may be to its author, is almost certain to possess some value or some novelty to others. We all appreciate carefully-written and elaborate papers, and feel grateful to the writers, who, at the cost of much time and trouble, come forward to instruct us. Such papers form, as it were, the dressed stones and carved work of our edifice; but after all it is to the smaller notes and communications that we must look for the chief material of the walls, and for the lime which will bind all into one substantial whole. Members, therefore, cannot be too strongly impressed with the fact, that while what may be called lectures and elaborate papers will always be most welcome, short notes, and plenty of them, are what are equally desirable at the present time.

Another point in relation to "papers" is this. From the nature of the membership of the Society, we are devoted as a body to no one particular branch of natural science, and many of our members, though interested in natural history generally, are not students of any particular department. On this account, perhaps, I think there has been a tendency in the papers to deal with scientific matters in a broad and popular manner rather than to enter into special and original details or observations. Authors doubtless feel afraid of being unintelligible or wearisome to the majority of their hearers, and have preferred to write for the many rather than for the few. But while the one class of papers are all that can be desired to carry into effect one of the objects of the Society, namely, "the promotion of the study of Natural Science," yet, if we are to do our work effectually,—if we are to take a place, however humble, amongst the Scientific Societies of the country,—we must not neglect the other class of communications. We do not look for long and learned papers full of original research. These will naturally be sent to wealthier and more central Societies than ours, but what we ought to ask for and to get are little notes bearing on the natural history of the district, relating to the habits, characters, distribution, or occurrence of Perthshire animals and plants. In giving these an author must put entirely aside the idea that few (if any) members are particularly interested in the subject of his note;—he must keep in mind that everything has a beginning, and that possibly the very communication of a note that he may consider uninteresting to his hearers may be the means of attracting some of them to the field in which he is working, and thus furnish him with a fellow-labourer. It must also be remembered, that if the publication of our "Proceedings" is continued, his note will be preserved for the benefit of other workers, present or future, and that as out of little grains of sand great rocks are built up, so little notes and observations go to form the groundwork of broad generalizations and theories.

Connected with "papers" is another matter to which I would like to allude, and which has an important bearing on the work of the Society. There has been too much of a tendency on the part of members of late years to look upon the meetings as lectures to which they come as mere auditors, not expected to take any active part in the proceedings. This is far from what should be the character of the meetings. They ought to partake more of the nature of conversaziones than of lectures, and there should be an endeavour on the part of every member to get up and take part in discussions on the papers read. In a word, what we require is more life in the meetings; and if some of the members will only set the example, there is little doubt but that what is now the exception will soon become the rule.

Again, there is yet another matter which will make our meetings both more useful and more interesting, and that is the exhibition of specimens. Having now got a proper place for a Museum, there will, I hope, be a constant supply of specimens to exhibit and discuss at the meetings; but, in addition to this, members should bring specimens of their own. These may be brought for one of two or more reasons. They may be brought because being likely to be of interest to some of the other members, or because they prove the occurrence of the object in a locality in which it was not previously known to occur, and which it is desirable should be recorded. But, in addition to these reasons, specimens may be brought because the bringer desires to learn something about them; and though possibly he might obtain the wished-for information by consulting another member privately, it ought to be kept in mind that what he himself desires to know may also be desired by others, and, therefore, he should ask for the information publicly.

In addition to the subjects of the reading of communications and the exhibition of specimens, there is another point which may be alluded to, and which it is very desirable should be clearly understood. Those to whom from time to time the Society has entrusted the management of its affairs have always been desirous that all classes of their fellow-citizens should participate in the advantages which the Society offers to its members, and with that in view formed a new class of membership to enable those, to whom even the small annual subscription of 5s might be an obstacle, to become members. There was

already (as in other Societies) a class of members from whom no annual subscription is required, and to this class some of our most energetic working members belong; but it was thought that others might wish to contribute something to the funds, and that the ordinary subscription might be beyond their means, so the Society has empowered the Council to recommend a reduction of one-half the subscription in cases where this seems desirable, and we trust that this will be taken advantage of. But in return we expect that such members will be really working members, who, either in the way of communications, exhibitions, or specimens, will help to carry out the objects of the Society. It may be known to some of you that in the north of England,—especially in Yorkshire and Lancashire,—there are many scientific Societies composed, in whole or for the most part, of working men. (I use the term "working-men" in its ordinary acceptation, though I hold that *that* is erroneous, for we are all—or ought to be—"working men.") Now, many of these North of England men are proverbially 'cute, and it might be worth while considering, if time permitted, whether the existence of the Societies is due to this 'cuteness, or whether the 'cuteness has its origin (or is at least more developed) by the studies which the Societies encourage. At any rate, what holds good for Yorkshire should hold good for Perthshire, and it is probable that many working men would find it beneficial to themselves to belong to our Society, and the Society would gain strength from such members. It has, indeed, always had such members—in fact, some of the founders were working men—but what I wish to take this opportunity of expressing strongly is, that there is plenty room in our ranks for more, and that, while glad to welcome all as members, we will be still more glad to get them as fellow-labourers in the field of science—that is, as effective working members.

But it is time to bring this brief sketch of the Society's past history to a conclusion. We have seen that it has, to the best of its ability, endeavoured to carry out the programme laid down by its founders nearly fifteen years ago; that in shade and in sunshine, through good report and through evil report, it has gone on steadily working for the promotion of the objects for which it exists; and that, with many disadvantages to contend against, it has (it is hoped) not been altogether—directly or indirectly—unbeneficial to the community at large. To-day is the beginning of a new era into which the Society enters with brightened prospects. To-day the Society comes into possession of a land flowing with many advantages almost unhoped for by its founders. But if these advantages are to be employed as they ought to be—if the future is to emulate the past—each member must keep steadily in view the objects for which he and his fellows are banded together. And it will be well if at the end of another fifteen years the Society can show as creditable a past as it does to-day.

2. "*Climatic and Geographical Changes in Post-Glacial Times.*" By Dr Geikie, F.R.S.

The author commenced by remarking that his object in this paper was to sketch in outline some of the more noted physical changes which had taken place in North-Western Europe since the close of the Ice Age or Glacial Period. It was necessary at the outset, he said, to define clearly the limits of this inquiry, and for this purpose he gave a comprehensive sketch of what are known as the glacial accumulations, and pointed out the succession of physical changes of which these various accumulations are the record. He showed how it could be demonstrated that vast regions in our Continent had been at one time covered with a great sheet of glacier-ice, which covered Scotland, Ireland, and the major portion of England; filled up the North Sea; buried all Scandinavia; occupied the basin of the Baltic, and flowed south as far as the 52d parallel of latitude in Germany. All the mountain-ranges of Europe were at the same time covered with perennial snow-fields, from which enormous glaciers descended to the low grounds, and advanced sometimes for almost inconceivable distances. From the terminal front of the ice-sheet, and from all the local glaciers of Central and Southern Europe, torrents and mighty rivers escaped, and carried vast quantities of gravel, sand, and mud down to the low-lying lands. Many of the lowland valleys would appear to have been wellnigh filled up with snow in winter time; and this snow, becoming frozen into a kind of névé, accumulated from year to year; so that the rivers in summer, when they descended in greatly-increased volume, were enabled to rise to high levels, and to inundate in this manner enormous tracts of country. Thus the fine mud carried down from the glaciated regions was deposited at levels raised sometimes several hundred feet above the bottoms of the valleys.

This extremely arctic condition of things by and by passed away, and the climate of Europe became so genial that the differences between the seasons were much less marked than they are now. The evidence for these changing climatic conditions was by no means confined simply to the appearances presented by the glacial and interglacial deposits themselves. Abundant remains of the mammals, molluscs, and plants which peopled and clothed our Continent in these times had been preserved, and their testimony confirmed and extended the proofs derived from a study of physical geology. Thus we found that while the cold climate prevailed, the arctic-alpine flora, which is now characteristic of Northern Norway and Sweden, formerly occupied the low grounds of Central Europe. At the same time rein-deer and musk-sheep lived in Southern France, the glutton frequented the shores of the Mediterranean, and marmots and other northern and alpine animals were its congeners there. The land-shells then living in Central Europe tell a similar tale;—amongst them northern forms are most

prevalent, while even in Southern Europe the old molluscan fauna bespeak colder and wetter conditions than now obtain in those low latitudes. Thus the animal and plant life was quite in keeping with the physical conditions of that cold epoch during which glacier-ice covered such extensive tracts in the temperate latitudes of Europe.

As evidence that those cold climatic conditions did not obtain persistently during the Ice Age, Dr Geikie then glanced at the facts in connection with the former presence in Europe of a fauna and flora very different from those which he had just described. Hippopotamus, rhinoceros, elephant, hyæna, lion, tiger, and a great number of temperate species, such as deer, urus, hare, rabbit, &c., wandered over all Central and North-Western Europe; while at the same time such plants as the fig-tree, the laurel of the Canary Islands, the Judas-tree, and such like, grew spontaneously in the latitude of Paris. It is remarkable that the remains of these plants are found commingled with others which are essentially temperate species. Such an association of species nowhere occurs now in Europe; and the inference to be drawn from the facts was simply this: that at the time those plants were growing the climate of Northern France and of Germany was exempt from extremes. The summers were not so hot and dry, and the winters were not nearly so cold. Precisely the same tale is told by the land and fresh-water shells which accompany that remarkable flora.

Dr Geikie then showed how the glacial deposits themselves contained intercalated beds of sand, silt, &c., which had yielded more or less abundant remains both of the arctic-alpine and southern faunas. And he pointed out that the evidence led to the conclusion, that the so-called Glacial Period was not one long continuous period of cold conditions, but was interrupted several times by intervening periods of mild and genial conditions. In short, the Glacial Period consisted of an alternation of cold and genial epochs.

Now, it was of the climatic and geographical changes which had taken place since the close of that remarkable alternation of strongly-contrasted climates that he was about to speak.

The Post-glacial deposits were those accumulations which had formed after the disappearance of the great snow-fields and vast *mers de glace*,—for the last stage of the so-called Glacial Period was one of intense arctic conditions.

The Post-glacial and Recent deposits were typically represented by our *peat-bogs*, *river and lake alluvia*, and *raised beaches*.

After describing the general structure, composition, and mode of growth of peat, and pointing out that it was essentially a marshy accumulation,—and one which indicated the presence or former presence of wet and humid conditions,—Dr Geikie went on to describe its geographical distribution over Europe. From his account it appeared that peat-bogs were most common, and attained the largest development, in Northern and North-Western Europe. In the South of Europe the peat-bogs were more local and isolated, and generally occurred at high elevations, as compared with the low-lying bogs of the North. At low levels in Southern Europe the bogs do not appear to be growing.

The facts connected with the appearance of buried trees in and underneath the peat-bogs were next dwelt upon. It was shown that these occurred on at least two levels in many countries in North-Western Europe. At the bottom of the bogs, oak, hazel, ash, and other leafy trees were the prevailing forms, although pines now and again occurred; and as the trees were very often rooted in the underlying sub-soil, there could be no doubt that they actually grew in place. Above this ancient buried forest came a variable thickness of peat,—from two or three up to six, eight, or more feet,—and this peat was covered by a second forest-bed, which in Norway and Sweden consisted exclusively of pine. In Scotland and Ireland a second forest-bed also occurs, the trees in which consist principally of pine, but in lowlying districts, oaks and deciduous trees are also present.

The next point of interest in the peat-bogs was their occasional occurrence at and below the level of the sea. These were the submerged peat and so-called submarine forests which were so commonly met with upon the low, flat, and shelving shores of our own islands and the opposite coasts of the Continent. By means of a large map, Dr Geikie then indicated the distribution of those submarine bogs and trees. These, he said, were the principal facts connected with the peat-bogs.

He then went on to describe the Post-glacial and Recent deposits of *alluvium*. These occur chiefly along the courses of streams and rivers, or along the margins of lakes and estuaries. Undoubtedly they were composed of the sediment carried down from the interior by running water. The appearances presented by the old alluvia were often indicative of larger rivers than now flowed in our valleys. The mammalian remains associated with the peat-bogs and freshwater alluvia represent a fauna very much the same as that which now characterises Europe. Some of the animals had no doubt been locally exterminated, such as elk, reindeer, wolf, and beaver in Britain; while a few

have either become extinct or still live in modified forms in our domestic breeds, such as the great urus and the long-fronted ox. None of these post-glacial deposits had ever yielded a single trace of any of the more characteristic of the mammals which occupied North-Western Europe during the mild stages of the Glacial Period. All these had disappeared from the European fauna. Again, the oldest human relics obtained from the post-glacial beds were Neolithic—that is to say, they pertained to what is called the New Stone period, when men in this and other countries of Europe used stone implements, which were often well-polished. The older or Palæolithic tribes of men lived in Europe during the preceding Glacial Period, but they had vanished from the scene along with the great pachyderms long before Neolithic man appeared in these latitudes.

Dr Geikie then proceeded to point out certain conclusions which could be established by the facts he had adduced. He showed that the phenomena presented by the submarine bogs and trees proved that the land had formerly extended seawards. Not only so, but the former greater horizontal and vertical range of forest trees in these islands and Scandinavia demonstrated that a climate better suited to an extensive forest growth formerly prevailed. This was very plain from the simple fact that Northern Norway, now bare and treeless, was formerly covered with forests all the way from Cape Lister in the south to Nordvaranger in the extreme north. Similar facts hold true of Northern Scotland, the Hebrides, Orkney, Shetland, the Færöe Islands, and Iceland. Since that great extension northwards of forest growth there has been not only a loss of land but a deterioration of climate.

The next subject taken up was that of *Raised Beaches*. These old beaches proved that the land has at one time been lower than it is now. The two best-known and most distinctly-marked beaches in Scotland occurred at the height of 25 to 30 feet and 45 to 50 feet respectively—the latter being of course the older of the two. The great carse-lands of the Tay and the Forth were formed beneath the level of the sea when the tide in those estuaries flowed many miles further into the interior than now. Remains and relics of Neolithic man occurred in the older of the two terraces, while relics of the Bronze and Iron Ages were met with in the lower and younger terrace. The relation of these ancient terraces to the buried forest-beds of the peat-bogs was then pointed out, and it was shown that the lower forest-bed and peat lay underneath the oldest or 45–50 feet terrace, while the upper forest-bed and peat rested upon the surface of that terrace and the 25–30 feet terrace. This succession held good both for Scotland and England, and also for Ireland. It was evident from these facts that the first great extension of forests took place long anterior to the formation of the raised beaches;—that afterwards the land was submerged to a depth of 50 feet or so, and then gradually re-elevated to a greater height than at present;—and that the second forest growth belongs to that final period of elevation. Upon the opposite coasts of the Continent evidence of similar changes was forth-coming; so that we were sure that the vicissitudes which accompanied the formation of the Post-glacial and Recent deposits of our islands were not local, but characterised a very large area of North-Western Europe.

Some interesting facts in connection with the shells of the raised beaches were then dwelt upon. It was shown that in the old beaches of Norway and Sweden, and even in those of Scotland, distinct traces of a more genial climate could be seen. Thus many shells of southern types occur in the shell-beds of Norway,—some of them being no longer denizens of the neighbouring seas,—while others, although still represented there, were not only much less abundant but of smaller size than in post-glacial times. In like manner great beds of mussel-shells occurred in raised beaches in Spitzbergen, but the mussel does not now live so far north. In Greenland we were confronted with similar facts, and the same had been recorded from the coasts of Nova Scotia and New England. Dredgings in the northern seas had also acquainted us with the remarkable fact, that living Mediterranean forms still occurred here and there in those regions. They had been met with off the coasts of Norway, the coasts of Shetlands, and the west coasts of Scotland and Ireland; and similar phenomena have been observed in the Icelandic seas. In the Gulf of St Lawrence the evidence under that head was very striking. Thus genuine colonies of southern molluscs occur in that gulf and off the coast of Nova Scotia, which are completely isolated from their co-species of the southern coast of New England, and surrounded on all sides by more northern forms. And not only so, but the evidence showed that at an earlier period these colonies were much more extensive.

Having completed his outline of the chief or leading evidence, Dr Geikie next proceeded to indicate the general conclusions which appeared to be forced upon us by a careful consideration of that evidence. During late glacial times, when the great snow-fields and glaciers were melting away, the arctic-alpine flora and fauna occupied the low grounds of Central Europe, but as the climate became less extreme, they gradually retreated northwards to higher latitudes, while such as remained in

Central Europe were compelled to retreat to the mountains by the incoming hosts of temperate species which crowded them out of the low grounds. There can be no doubt that, after the final disappearance of our ancient *mers de glace*, it was this arctic-alpine flora that clothed the British area. Our commonest animals at that time were reindeer, elk, and so forth. As these northern plants and animals retired to higher latitudes, they were closely followed by the great body of temperate species which constitute what is now the prevailing flora of Great Britain and similar latitudes of the Continent. Our islands had thus been clothed and peopled by plants and animals which had immigrated from the Continent; and as this immigration took place in post-glacial times, it showed that the British area after the disappearance of arctic conditions formed part and parcel of the European Continent. And not only so, but as the present floras of the Færöe Islands and Iceland are Scandinavian in type, and as they could not have existed in those islands during the last glacial epoch, it follows that they must have been introduced in post-glacial times. This, as Dr Geikie remarked, implied a continuous or nearly continuous land-connection between those far-off islands and the European Continent,—the connection in all probability having been by way of Scotland and the Outer Hebrides. A submarine ridge at about a depth of 200 or 250 fathoms extended across from the Hebrides to the Færöes, and this is probably the submerged land-connection which obtained in early post-glacial times.

Haviug pointed out the facts bearing upon the question of changes in the geographical outline of North-Western Europe, that of climatic changes was next considered. It was pointed out that the former greater abundance of southern species in our northern seas denoted a formerly higher temperature for those waters. These southern forms were now dying out. It was self-evident that the immigration of these species into our area must be of post-glacial date, since it is quite impossible that they could have outlived the conditions that obtained during the last glacial epoch. Clearly, then, the Gulf-stream, within a comparatively recent period, had flowed into these northern seas in a much greater volume. And these facts and inferences were in keeping with the evidence supplied by the buried forests of the peat-bogs. At the time Mediterranean molluscs were immigrating into northern seas, oaks and pines were covering immense regions which are now bare and treeless. This was what he termed the genial post-glacial period. It is to this period that the lower buried forests of our peat-bogs belong.

The next stage is represented by the raised beaches, which indicate a former submergence of the land. The British area then became insulated, and the climate deteriorated. The great forests decayed more or less rapidly, and became buried in growing peat. The climate was at once humid and cold: the humidity giving rise to a vast increase of the peat-bogs throughout all North-Western Europe;—and the cold once more causing perennial snow-fields and glaciers to appear in Scotland. At this time the sites now occupied by all our great seaport towns were under water. All the wide carse-lands of Forth and Stirling and Gowrie were drowned, and Neolithic man lived along what were then the sea-coasts, where he has left piles of shells, and other relics, such as harpoons, stone hammers, hearthstones, &c., to testify to his former presence.

Eventually the climate improved, and the sea at the same time retreated to a lower level than at present. Again the forests began to spread, and this so vigorously that they by and by covered wide areas which had formerly been waste heath and bog. This was the period of the upper or newer forest-bed of the peat-bogs in this country and the Continent. It was followed by a final submergence of the land, during which the climate would appear to have again become colder and more humid, and thus encouraged a new and vigorous growth of peat, underneath which wide areas of forest-land were eventually buried.

The last great change has been a retreat of the sea from the 25 to 30 feet level to its present position, probably accompanied by a lessened humidity, as would seem to be indicated by the fact that the peat-bogs over wide areas in Norway, Sweden, Denmark, Germany, and our own slands, appear to have ceased to extend themselves,—in many places, indeed, they are even dying out and decaying away.

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## *ANNUAL DINNER.*

DECEMBER 16th, 1881.

THE Annual Dinner took place in the Salutation Hotel, Perth, on Dec. 16th. The President, Dr Geikie, F.R.S., occupied the chair, and there was a good attendance of members, who, as usual, alone had the privilege of being present.

In proposiug the toast of the evening, "The Perthshire Society of Natural Science," Dr GEIKIE insisted upon the importance of every member being, so far as in him lay, a

working member. They had incurred great obligations to the public for the noble support which had been accorded to them, and they must discharge them honourably by striving to make the work of the Society as perfect as possible. He (the chairman) had, in the course of his professional duties in connection with the Geological Survey, traversed a large part of Scotland, and become intimately acquainted with many districts, and he could say that there was none more interesting than Perthshire; and though he had the misfortune not to be a Perthshire man by birth, yet he had become so familiar with the county that he had, he thought, partly become a son of Perthshire. Dr Geikie then alluded to the success of the late bazaar, which had more than exceeded their expectations. If, however, their Museum Scheme was to be fully developed, a little more money would be necessary, but this, he had little doubt, would be forthcoming in time.

The next toast was "The Lord-Provost and Magistrates," who, said the chairman, had always taken a great interest in the welfare of the Society.

After a brief reply from the Lord-Provost, Mr Robert Pullar proposed "The Memory of Sir Thomas Moncreiffe," and expressed the great sorrow they all felt that Sir Thomas had not been spared to see, as they had, the realization of his dreams regarding the Museum. After alluding to the great indebtedness of the Society to Sir Thomas, Mr Pullar said that he wished to take this opportunity of announcing a donation which had been given to the Society in the shape of the marble medallion of their late President, which they had all seen at the bazaar. This medallion had been won by Mrs Fleming of Inchyra, and that lady had, in the most generous manner, given it to be preserved in the Museum buildings, where, though she valued it very highly, she thought it ought to be. They would all, Mr Pullar was sure, greatly appreciate Mrs Fleming's kindness. The toast was drunk in solemn silence, and was suitably acknowledged by Sir Robert Moncreiffe.

The Rev. Dr Milroy, of Moneydie, proposed, in felicitous terms, the health of the President, from whose connection with the Society they had all derived so much benefit. The toast was drunk with all the honours.

Dr Buchanan White proposed "All Friends around Ben Lawers," which, as he explained, meant all who, directly or indirectly, promoted the objects of the Society. Amongst the latter were all Scientific Societies at home and abroad, who were friends in the sense that their objects —viz., the study of natural science—were the same, and who, therefore, ought to be commemorated in a gathering like the present. He, however, wished to include more particularly in this toast all the friends who had helped them to the realisation of their Museum Scheme, and most especially the ladies who had, at the cost of great trouble and fatigue, either as stallholders or assistants, helped so efficiently to make the Bazaar the great success it was. After giving some particulars of the pecuniary results of the Bazaar, Dr Buchanan White said that it was proposed that this toast should be coupled with the name of ex-Provost Richardson, who, as all present could testify, had proved himself a true friend; but as that gentleman was unfortunately absent from illness, he would ask them to join in it the name of Mr Dawson, one of the founders of the Society, and who had all along given many proofs of his warm interest in it.

Mr Dawson having replied,

Mr Andrew Coates proposed "Science and Scientific Education," to which Councillor Jackson replied.

Ex-Bailie M'Neill proposed "The health of the Secretary and other Officers," for which the Secretary, Mr John Young, returned thanks.

Mr John Macgregor, Postmaster, proposed the health of Mr John Sim, associate of the Society, and one of its oldest members, whose botanical attainments, and the readiness with which he was always willing to impart his stores of information to others, were well known to all present. After a few words from Dr Buchanan White in support of Mr Macgregor's statements, Sergeant Sim replied, remarking that in the course of a long and varied life (he was now above 70 years of age) he had in his humble way always endeavoured to communicate to others the pleasures he had derived from a study of Nature.

Mr Skeete proposed "The Flowers of Perthshire," which toast, he explained, meant the ladies, and especially the lady-members of the Society, laying stress on the fact that without the assistance that had been so heartily given by the ladies the Society would not be in the healthy financial condition in which it now was.

Mr J. B. Campbell replied to the toast, and took occasion to express his belief in the benefits that would result to the community at large, not forgetting the working class, of which he was proud to be a member, from the Society and its museum.

During the evening songs were sung by various members, and the meeting, which was free from all formality, was enjoyed by all present.

January 5th, 1882.

Colonel DRUMMOND HAY, C.M.Z.S., Curator, in the Chair.

NEW MEMBERS.

The following new members were elected :--Dr Simpson; the Rev. Mr Dickie; the Rev. Mr Dodd; Mr D. Galloway, Vinebank, Kinnoull; Mr Paul Darling, Elcho; Mr George Pitcaithly and Miss Pitcaithly, Elcho; Mr James Gaudie, Postal Telegraph Office; Mr John G. Millais, Marlborough; Mr Hugh Crawford, Moneydie; the Rev. John Ferguson, Aberdalgie; the Rev. Canon Hodson, South Methven Street; Mr James Milne, M.A., teacher, Little Dunkeld; Mr J. Scott, General Prison; Mr Alexander Jamieson, Barossa Place; Mr James Stewart, L.D.S., Princes Street; Mr James Sime, 292 High Street; Mr James Fenton, Burnside, Craigie; Mr William Bruce Gowans, St Leonard Bank; Mr Charles S. Whittet, Barossa Place; the Rev. Andrew Benvie, Scone; Mr James Brebner, Dundee; and Mr Alexander Westwood, Princes Street.

The following were nominated for election as members :—Mr D. Simpson Dow, Springbrae, Kinnoull; Mr J. Henderson, jun., Albert Place; Dr Henry Laing, Bridge of Earn; Mr Gray, Bowerswell; Mr Thomas Moncrieff, St Leonard Street; Mr Bain, County Assessor; Mrs Gibson, Athole Place; Mrs Dickson, Greenbank; Miss Dickson; Miss N. Miller, Mayfield; Miss Etta Miller; the Rev. Archibald Fleming of Inchyra; Mr Peter M'Glashan, High Street; Bailie Gow, Rose Terrace; Mr William Barlass, Scott Street; Mr Watters, Scott Street; Mr James Hewat, Watergate; and Mr George Wells, Queen Street.

DONATIONS.

The Secretary intimated that the following donations had been received, and thanks were voted to the donors :—

*For the Library.*—Bas-relief portrait in marble of the late Sir Thomas Moncreiffe, Bart., sculptured by Mr Beveridge, and presented by Mrs Fleming of Inchyra; large bookcase, by Mr Robert Pullar, F.R.S.E.

*For the Perthshire Natural History Collection.*—Scaup duck, capercailzie, and two ptarmigan,—all from Rannoch, by Mrs Robertson, sen., of Struan; spotted crake, pair of jack snipe, dipper and jay, by Mr May, General Prison; pair of crossbills, by Mr Malloch, Perth; chub and great pipe fish, by Mr Speedie. Large collections of Perthshire plants from Dr Buchanan White; Mr James Coates; the Rev. Mr M'Naughton, Kinclaven; Mr A. Sturrock, Rattray; Mr C. Macintosh, Inver; Mr James Brebner, Dundee; and Mr John Dawson, Perth. A series of rock specimens from the celebrated geological locality at Dal-an-Eas Bridge, Glentilt, and from Rannoch, by Dr Buchanan White; badger, by the Very Rev. Provost Burton.

*For the Index or Type Collection.*—Two large boxes of geological specimens, from Mr Grant of Kilgraston; collection of geological specimens from the Rev. Mr Swan, Comrie; collection of corals from Mrs Marshall of Duncrivie; specimen of Colorado silver ore, from Mr Duff, Bank of Scotland, Dunkeld; bone of species of Moa, from Mr Gray, Bowerswell; and Platypus, &c., from Mr Wanliss, Australia.

ADDITIONS TO THE LIBRARY.

The Secretary also intimated that the following additions had been made to the Library :—

*I.—By Gift or Exchange.*—"Some Thoughts on the Distribution of the British Butterflies." By F. Buchanan White, M.D., F.L.S.; "The Scottish Naturalist," Nos. 43 and 44; "Journal of the Royal Microscopical Society," Dec., 1881; "Transactions of the Epping Forest and County of Essex Naturalists' Field Club," Part 4; "Transactions of Hertfordshire Natural History Society," Parts 5—7; "Proceedings of the Perthshire Society of Natural Science," Vol. I., Part I; "Le Naturaliste," Nos. 51—65; "Boston Journal of Chemistry," May — Dec., 1881; "Science Gossip," Nos. 197—204; "Midland Naturalist," Nos. 41—48; "The Naturalist," Nos. 70—78; "Entomologische Nachrichten," 1881, Nos. 9—24; "Entomologisk Tidskrift," 1881, No. 2; "Revue Bryologique," 1881, Nos. 4—7; "Canadian Entomologist," 1881, Nos. 7—11; "The Scientific Roll," Nos. 1—4; a bundle of pamphlets, by Dr Buchanan White, F.L.S.

*II.—By Purchase.*—"Journal of Botany," Nos. 221—228; "Nature," May — Dec., 1881; "Entomologists' Monthly Magazine," Nos. 205—212; "Micrographic Dictionary," Parts 1—6; "Illustrations of British Fungi," by M. C. Cooke, Parts 1—5; "British Moss Flora," by Dr Braithwaite, Parts 3 and 4.

Dr BUCHANAN WHITE said he had received the following letter from Lady Louisa Moncreiffe, in reply to one which he had been instructed by the Bazaar Committee to send to her asking her acceptance of the gold medallion of the late Sir Thomas (which was exhibited at the recent

Bazaar), as a memento of what he had done for the Society :—

59 Ennismore Gardens, Prince's Gate, S.W.,
London, December 28th, 1881.

DEAR DR WHITE,—It gave me great pleasure to receive your letter of the 20th inst., with so satisfactory an account of the results of the Bazaar, the success of which has been so much owing to the great trouble you and the Committee have taken with it throughout. It would indeed have been a happy day for Sir Thomas had he lived to see his much-desired object realised to what would have been the very utmost of his wishes. I can assure you it is a great pleasure to me to feel that this has been the case. I cannot express how deeply I appreciate the kindness of the Bazaar Committee in thinking of me, by sending the beautiful medallion that I have received from them; and I must ask you to convey to the Committee my warmest and most grateful thanks for their kindness. I shall indeed value the gift, not only for the intrinsic value of the medallion, but by the knowledge that in sending it to me it proves how truly the Committee still cling to the remembrance of their much-beloved late President, and value the great interest he ever took in the work, which I trust may now prosper, as it has begun, to the utmost wishes of all who have done so much for it. With repeated thanks for your kind letter, believe me, dear Dr White, yours very sincerely, LOUISA MONCREIFFE.

On the motion of the chairman the letter was ordered to be engrossed in the minutes.

The following papers were read :—

1. "*Local Meteorological Conditions, and Conditions of Local Meteorology.*" By Mr James Moncur.

From the earliest times the relation of the signs which appeared on the face of Nature, as she spread out her panorama of earth, sea, aud sky, have been closely observed and recorded by people in every country whose language has been a written one. And in the most degraded of human races the utterance of the elements, as the thunder has rolled in the canopy of cloud overhead, the lightnings shot their thunder-bolts of fire, and the winds howled like demons in the tempest, have aroused in the savage mind the feelings of fear, dismay, and awe. Whilst these occasion dread and fear to the savage soul (taming it with music peculiarly their own), they have lent inspiration to the grandest of poets, and have given loftiness and majesty to their epics or dirges, as they wrote the one or chanted the other. Some of our noblest fictions are continuous psalms, phrased to the rhythm of ocean's cadences, or the brook's ripplings, and the sighings of the zephyrs, as they have sung in softest lullaby the heroes and heroines of their stories to a tranquil sleep—sometimes that of death. Who that has read Ossian, or Victor Hugo's "Toilers of the Sea," but can realise how fully such descriptions are verified; whilst in the front rank of such imagery are the Sacred Canon and Shakespeare's gifted plays. So much, however, by way of introduction, to what I find, must needs, at the beginning, be somewhat of a literary, as much as a scientific, paper.

My paper is made up of two parts, which I will deal with in their order, not in an exhaustive manner by any means, but only so far as the limited time allowed me from other avocations and duties have on the present occasion permitted. In my observations I mean to confine myself more immediately—1st, to the city and its surroundings, within a two-miles' radius from its centre; and, next, to the country beyond this line and immediately adjacent; and, thirdly, to places more distant, but having some corresponding resemblances in their situations on the records of their meteorological observations. The position of Perth—only 25 feet above the sea-level, and about as many miles from the ocean, traversed by the beautiful river which flows alongside of us, intersected by canals, and surrounded on all sides (except the gorge through which the river flows east and north and north-west) by ranges of hills—renders its atmosphere damp and chilly. Shut out from the genial influences of south-west winds, and fully open to all the rudeness and severity of Boreas' blasts, its air is normally cold and raw. Again, the prevailing gusts of east wind which sift themselves through our clothes in the spring months, and penetrate every hole and chink in our houses, drying up the pores of our skin, producing all the aches and biliary complaints congenial to such circumstances, are the happy experiences of the men and maidens of the Fair City, for at least one-third of the year.

The barometer at Perth, whilst I was observer, was 36 feet above the average meantide-level. It was, as all instruments recommended by the Meteorological Society are, an upright mercury tube, and was compensated to suit the expansion and contraction of the metal; and, taken along with thermometer and hygrometer, I found the place where the observations were made, at the General Prison, quite a good enough one for observing, and sufficiently sensitive to give early notice of previous changes of the weather with very considerable accuracy.

In the neighbourhood of a growing city it is somewhat difficult to find out free conditions for taking satisfactorily the true meterological state of the place where the town stands, without such observations being influenced by the houses and works of the population. No such drawbacks are, as a rule, to be found in our modern cemeteries, as men are generally foolish enough to choose some open healthy spot to rest in when they die—however they may be housed

when alive—hence it has been common to have such observations recorded in cemeteries where the dead are under the constant attention of some watchful eye. The North and South Inches would make splendid stations for meteorological observations, as they are on the same level as the bulk of the town, and exposed to all the changes of weather to which it is subject.

The hills which surround the city keep off the force of winds and weather, whilst they also exclude the beneficial effects which especially come from south-west winds. This exclusion from a free exposure to all the influences to be got by an open situation tells much against the city in times of fog and hoar-frost in the winter season, when the damp exhalations from the river rise to settle again in a frozen form, wherever they alight. The rift between the hills of Kinnoull and Moncreiffe acts also as a funnel through which a draught of wind is continually flowing across the city, and that always of an ungenial kind. This gateway to the sea, which, as may be seen in these winter mornings, as the sun gets up out of his lair in the east, is a splendid barometer for weather-observers to gauge and study the science by, and predict therefrom what in these hard times of trade competition everyone requires to watch more closely.

The sunsets on the hills to the north and north-west are sometimes, in winter, beautifully kindled by an intense bright fiery circle of luminous cloud, which can be often traced for hours in the distant horizon, as its effulgence gradually changes into the clear deepness of a dark ethereal blue, spangled with stars, sparkling as diamonds in the solemn grandeur of celestial quiet and majesty.

Other conditions as to situation might be referred to, such as rainfall, &c. As regards the moisture, all other things being equal, I believe it is an understood fact that a place at a low sea-level has a larger rainfall than that which stands higher—consequently rain-gauges in the neighbourhood of the city, but not on the same level, record greater or less rain according to their altitude. The average rainfall of Perth is somewhere about 34 inches, and the place where observations — rainfall and temperature—come nearest this in the Registrar-General's weekly reports, is Paisley, which, as some of you may know, possesses many things common to ourselves,—being about a like distance from the estuary of the Clyde, having the River Cart passing through it, and being also surrounded on the west and south-west by rising ground similar to Perth.

We have no fogs with a north-west wind, and very rarely snow, and more seldom rain. I have observed the soft heavy flakes of snow come most when the wind is in a south-west direction; and that fogs prevail when the wind is off the east, immediately after a dry period, and also when the drifts of the upper current of air is from the north-west or north. The fogs from the east, previously referred to, are most common in the summer time, and arise, I think, from the intense heat at sea and further south being drifted inwards off the sea, as the warm steam from the ocean and colder inland air of the early summer months change places.

The bulk of our rain comes from the east,—never failing, when it is carried cloudwise over the top of Kinnoull, to drench and purify the streets of the fair, yet filthy city.

Our hails, in the summer months, come in time of early heat from the congealed vapours chilled by a top current of north-west air solidifying the drops of rain formed out of the layers we see floating about.

Our sleets, again, are almost invariably the gift of the north-east, and bitterly cold and keen they are.

The area of hoar-frost in the neighbourhood of Perth I have not yet discovered, but the fogs, I know, are seldom to be seen in the west, and never 90 ft. above meantide.

From the month of September on to the end of February, west and south-west winds are most prevalent. From March on to June, east, north-east, and north-west winds are the most prevalent, and in July and August west and south-west winds.

In the course of my observations I have noticed that thunder-storms come mostly from the south, and I do not think I ever knew of a case of a thunderstorm from the north. My idea of the cause of this is that the electricity evolved in a highly-rarified atmosphere, by heat or other causes, acting on the earth's surface, are, on account of their lighter character, borne into a denser atmosphere, and coming into air of a different character, the detonation takes place which we call thunder.

I have noticed frequently that, in the spring months of March and April, the country adjacent to Edinburgh, in the neighbourhood of Ratho and Dalkeith, was often no further advanced at such times in vegetation than we see north here. Visit the same places, however, six weeks later, and you will find that vegetation in our own place is laggard; and whilst the potatoes may be growing and filling the drill, these with us have not passed beyond cleaning with the hoe. The reason for this is that until the beginning of March the influence of east winds do not affect the verdure or growth of seeds and plants. The advancing season causes a large quantity of vapour to rise from earth and sea, and this, borne towards us, is met by the cold winds issuing from behind our background of Highland

hills, which, scouring over the plain intervening between these hills and us, brings all the dry vegetation it meets with on its way south, until it strikes the vapour brought from south and east, which it casts in dense sheets of rain on the stiff clay soil in and around our neighbourhood.

So much for the first part of my subject.

Now, as to the conditions of local meteorology. Though the Fair City has made many strides in various things, yet in this, one of the most interesting of studies, she has made no real progress; rather the reverse is the case. Previous to my taking up the observations, they were made by General Lindsay at Craigie; and since I gave it up, Mr J. F. Pullar is working away at Rosebank with a set of instruments. The position of Rosebank is, however, rather elevated; and though observations there are better than no observations at all, yet it does not come under the same influences as we do at a lower level, being sheltered by the hill at its back,—sloping to the south and south-west winds; and though not without the influence of fog and hoar-frost from the river, still they are more rare than down in the city, and not nearly as dense when they do reach as high, nor yet by any means of so frequent occurrence. Dr Bower makes some observations for himself, I understand, at his residence. There are also rain-gauges at the Seminaries, and in some parts of higher Bridgend; as also at Methven Castle and Scone Gardens. The adjacent station of the English Society at Glenalmond College was very complete in Dr Robinson's time, and reported regularly to the office of that Society. Stations of the Scottish Society are to be found scattered throughout the county—at Trinity-Gask, at Auchterarder, at Crieff, and Coupar-Angus, of which latter the astronomical railway porter has some charge.

I have found great benefit from the reports of the night-watchmen connected with the General Prison, who reported the fall of meteors, thunder-storms, lightning, and auroras occurring during the night, and occasionally that very beautiful phenomenon—a lunar rainbow. I think our policemen might often be as profitably employed taking a glint upwards during the course of their midnight patrols, as hanging their heads over the fumes of their lamps. I find that, without any instruction to do so, such men, out of dead weariness, do note such things; and I think it would add very much to what we do know, if what could be no great trouble to them could be carried into practice.

2. "*Notes on the Season.*" By Dr Buchanan White, F.L.S.

As relating in some degree to the subject which Mr Moncur has just brought before us in so interesting a form, I have thought that a few notes on the mildness of the season, as exemplified by the flowering of certain plants, might not be amiss. I daresay that many of you have noticed in the papers lately various paragraphs relating to certain plants being in flower, though in most cases there is nothing very remarkable in the examples given, except in the contrast that this winter has hitherto presented to those of late years. Moreover, if such observations are to be of any real value, record should be made of the situation, soil, &c., of the spot in which the plant is growing; and when the phenomena of one year are to be compared with those of another, it is very desirable that, when possible, the observations should be made on the same individual plant. Those who have given any attention to the leafing of trees or flowering of plants cannot fail to have observed, how, apart from the accidents of situation and soil, some individuals—in no very evident way more favoured than their neighbours—are yet always in advance of them. For example, there is a horse chestnut,—the first of the row of trees on the Bowerswell Road,—which I have now watched for several years, and which is always earlier than any other tree that I have seen in this neighbourhood. It is interesting to note this, but if it was desired to obtain a fair idea of the usual time of the leafing of the horse chestnut in this neighbourhood, it would be better, I think, to select some other tree than the one I have just mentioned, for observation. At the same time, an individual tree should be selected.

The specimens I now show do not, I fear, prove very much beyond the fact that this winter is somewhat milder than those we have lately experienced, for though in some cases I am able to tell you the dates of flowering in previous years, yet as—from alterations in my "rock-garden"—the situation of the plants is somewhat different, and the individuals from which they are taken are not the same, the comparison is scarcely a just one:—

| | 1878 | 1879 | 1880 | 1881 | 1882 |
|---|---|---|---|---|---|
| Daisy (*Bellis perennis*),.......... | Feb. 9 | Mar. 7 | Jan. 1 | Mar. 15 | Jan. 1 |
| Aubrietia purpurea,.. | Feb. 9 | Apr. 12 | Mar. 23 | Apr. 5 | Jan. 1 |
| Arabis procurrens,... | Jan. 1 | Mar. 20 | Feb. 25 | Apr. 15 | Jan. 1 |
| Arabis albida,........ | Mar. 25 | Apr. 20 | Mar. 5 | Apr. 12 | Jan. 1 |
| Potentilla alba,...... | Jan. 1 | Feb. 7 | Feb. 9 | Apr. 15 | Jan. 1 |
| Veronica rupestris,.. | Jan. | Mar. 10 | Apr. 17 | Apr. 29 | Jan. 1 |
| Potentilla fragariastrum, ........ | Feb. 6 | Feb. 28 | Feb. 18 | Apr. 1 | Jan. 1 |
| Senecio vulgaris (Groundsel), .... | | | | | Jan. 1 |
| Viola odorata (Violet) | | | Jan. 7 | Apr. | Jan. 1 |
| Primula vulgaris (Polyanthus), .... | | | | Apr. 6 | Jan. 1 |
| China Roses,........ | | | | | Jan. 1 |
| "Christmas Roses,".. | | | | | Jan. 1 |

In addition to these, several other species are in bud,

including *Anemone hepatica*, *Chrysosplenium alternifolium*, *Doronicum Caucasicum*, *Primula Cashmeriana*, *Saxifraga Burseriana*, *Draba aizoon*, &c.

To refer again to the newspaper paragraphs. You may often see the appearance of butterflies noticed as remarkable indications of the mildness of the season. Now, as there are three or four kinds—one very common—which hibernate, or live all winter, in the perfect state in this part of the country, there is really nothing very remarkable in these appearances. The butterfly which is the one usually seen is the small tortoiseshell *(Vanessa urticæ)*, which at the approach of winter retires to any dark or sheltered corner, and there passes the cold weather in sleep. As a rule, these butterflies do not re-appear again till spring, but it sometimes happens that they are aroused by some cause, and produce amazement by their unexpected appearance.

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## February 2nd, 1882.

R. Pullar, Esq., F.R.S.E., Vice-President, in the Chair.

The Secretary announced that a class for instruction in the use of the microscope had been formed in connection with the Society, towards defraying the expenses of which a sum of £50 had been voted by the Council. He also mentioned that £100 had been voted for the Reference Library. Both votes were sanctioned by the meeting.

### NEW MEMBERS.

The following were elected members:—Mr David Simpson Dow, Springbrae, Kinnoull; Mr John Henderson, jun.; Dr Henry Laing, Bridge of Earn; Mr Gray, Bowerswell; Mr Thomas Moncrieffe; Mr A. Bain; Mrs Gibson, Athole Place, Perth; Mrs Dickson, Greenbank; Miss Dickson, Greenbank; Miss N. Miller, Mayfield, and Miss Etta Miller; Rev. A. Fleming; Mr P. M'Glashan; Bailie Gow; Mr Wm. Barlas, Scott Street; Mr Waters; Mr George Wells, Queen Street; Mr Nicol Fairland, Dundee; Mr Lorimer, King Street; and Mr J. Hewat, Watergate.

The following were proposed for election at next meeting:—Mr William Mair, 13 Marshall Place; Mr David Marshall, Inchview Villa, Balhousie; Mr William Martin, schoolmaster, Aberuthven; Mr David M'Lagan, Burton Place, Nelson Street; Mr Robert M. Kippen, Marshall Place; Mr A. S. Leitch; Dr Morrison, Dunning; Mr David Macgregor; Mr A. Davidson, York Place; Mr R. Hay Robertson, jun.; Mr Thomas Wyllie, 7 George Street; Mr James Fisher, 7 George Street; Mr John Henderson, sen.; Mr James M'Nicol, High Street; Mr Charles Grego; Mr W. A. Paterson, Croft House, Craigie; Mr J. Martin White (Spring Grove, Dundee) of Balruddery; Mr J. M. Kirk, Athole Street; Mr Wm. Robertson, High Street.

### DONATIONS.

The following donations were intimated:—I. For the Index Collection—Fossils from the Blue Lias by Dr F. R. Wilson, The Durn; wooden case from Mr Gardiner, Barnhill; specimens from Queensland and New Zealand, from Mr John Armstrong, Mansion Neuk, Methven. II. For the Perthshire Collection—Nodules of clay from the Muirton farm; stoat weasel from Mr William Hunter, Balharry, Meigle; common buzzard and two bullfinches (male and female), from Mr Charles Ford, gamekeeper to Sir Donald Currie, at Garth; capercailzie (female), from Mr J. F. Pullar; two redpoles (male and female) and a siskin, from Mr W. Perso, Blargowrie.

### NOMINATION OF OFFICEBEARERS.

The following members were recommended by the Council for election as officebearers for Session 1882–83:—President, Colonel Drummond Hay, C.M.Z.S.; Vice-Presidents, Mr R. Pullar, F.R.S.E.; Sir R. D. Moncreiffe, Mr Magnus Jackson, F.S.A.Sc., and Mr John Stewart; Secretary, Mr John Young, C.E.; Treasurer, Mr John Macgregor; Curator, Colonel Drummond Hay; Librarian, Mr James Coates; Editor, Dr F. B. White, F.L.S.; Councillors, Mr Ellison, Mr John Dawson, Mr P. D. Malloch; and as *ex officio* members of Council the Trustees, Colonel Drummond Hay, Dr F. B. White, Mr R. Pullar, and Mr A. Coates.

### HONORARY MEMBER.

On the suggestion of the Council, the President, Dr Geikie, whose appointment as Professor of Geology in the University of Edinburgh necessitated his departure from the district, was unanimously elected an honorary member of the Society.

The following papers were read :—

1. "*On the Causes which determine the Distribution and Limitation of the Lower Animals.*" By the Rev. Thomas Brown, Collace.

It is not necessary, said the author, to occupy time in proving the necessity which there is for the movements of the lower animals being restrained, and for their being confined within certain definite limits. For it must be evident to every one, that if they had been allowed to roam about without any check being imposed upon them, the ends which God had in view, both as regards man and the animals themselves, would have been entirely defeated. And instead of the peace and harmony which at present exist among the various orders of creatures around us, the direst confusion would have prevailed, terminating at last in the total destruction of many orders and species. Mr Brown then proceeded to point out some of the ways by which God accomplishes His purposes as regards the distribution and limitation of the lower animals, while He at the same time secures for them that freedom of will which, under certain restrictions, He has been pleased to bestow upon them, and promotes their happiness.

2. "*The Modes of Dispersion of the Seeds of Scottish Wild Plants.*" By Professor J. W. H. Trail, M.A., M.D., F.L.S.

The subject that I have selected to put before you at this meeting is one of considerable interest and importance from several points of view. This interest is rendered still greater to evolutionists, alike by the effort to explain the origin of the various adaptatious for dispersion of seeds met with among plants, and by their bearing on the value of characters to the systematist in his endeavours to approach a natural system of classification. Observation and experiment have shown that the vegetative organs of plants (stems, leaves, &c.), vary greatly in most species when the conditions around them are changed, *e.g.*, in poor or stony soil as contrasted with rich fertile ground, in open or in shady places, and so forth; hence the amount of importance attached to diversities in these parts is very limited. On the other hand, the organs of reproduction (*i.e.*, flowers, fruit, and seeds), are less directly exposed to the influence of surrounding conditions; and, save in number, and to some extent in size, they are hardly modified by the influences that so markedly act on the organs of vegetation. Accordingly, they are found to be far more constant in form and in structure, and hence are chiefly used by systematists. But the flower and fruits, though but little affected by the causes above mentioned, are yet exposed to influences from which the other parts are exempt. These seem to have in course of time had a great effect in modifying the structure of both flowers and fruit in many plants to suit the conditions under which they live. These influences as regards flowers have been studied by careful and enthusiastic observers in Great Britain, but more especially in Germany; and numerous works, some of great merit, have been written on them and on their effects.

In the flowers the great requisite is the conveyance of the pollen from the anthers to the stigma, so as to fertilise the ovules. In many plants this is effected by the wind, but in others insects are the bearers of pollen; and it is in these that we meet with the most striking and beautiful forms of flowers. There is reason to believe that very great modifications of form and structure have been brought about in these in course of time, suiting them for visits of insects, the structure of which specially enables them to convey the pollen aright, while colour and size have also been greatly affected in the same way. Hence characters liable to such influences must be used with much caution.

In the fruits modifications are beneficial for a new object, viz., the wide distribution of the seeds, and the agents are for the most part different; hence the modifications resulting from their action are of a different nature. Frequently the result may be attained in closely allied plants by modification of distinct parts, while the same means may be employed in two or more plants not at all closely related. Therefore, care is required to distinguish between such adaptational resemblances and those due to relationship, as they are of very different value to the systematist and to the genealogical botanist. Examples of close resemblances in fruits of widely distinct species and of differences in those of closely allied species will be noted in the sequel.

It is unnecessary to dwell long on the great advantage that plants derive from wide distribution of seeds. When widely distributed there is, it is evident, a greater likelihood of some being brought into favourable conditions for healthy and vigorous growth. On the other hand, however favourable the conditions may have been to the parent plant, were all the seeds to fall close around it and to germinate there, it is evident that there could not be room for the healthy growth of the progeny. It is well known that the same crops cannot be grown for several years continuously without impoverishing the soil by the removal of certain ingredients that must be artificially replaced to keep that soil fertile. The same holds good with wild plants; hence advantage ensues from the young plants

not occupying the same spot as the parent. Moreover, as they necessarily take the same substances from the soil, the struggle for existence is more severe between plants of the same species than between plants of different species, and this holds still more with the offspring of the same plant; hence it is of great advantage to the young plants to be scattered to some distance from one another.

After these preliminary remarks, I shall now go on to notice some of the various adaptations that favour the dispersion of seeds. These adaptations are frequently far more striking in exotic species than in any of our native plants, but I shall almost restrict myself to the latter, in the hope that it may excite the attention of some of you to what may be verified at home, and may induce you to enquiry into a subject that has been comparatively neglected among us.

The agents in the dispersion of seeds are :—

1. Wind, in many species.
2. Water, in a few.
3. Animals, almost solely quadrupeds or birds. They convey seeds, or one-seeded fruits, from place to place (*a*) attached to hair or feathers by means of hooks, prickles, or sticky surfaces ; (*b*) they swallow the fruits, and the seeds are discharged uninjured from the intestines almost always at some distance from the place where they were swallowed. The seeds of plants growing in shallow water and siuking into mud are often conveyed, as pointed out by Darwin, on the feet of wading birds to considerable distances. But in this case there are no special adaptations of structure necessary, so there is no need to refer to them at greater length.
4. In some plants the seeds are thrown to some distance by elastic dehiscence of the seed-vessel, *e.g.*, in the broom, or of a seed-coat, as in the wood-sorrel.
5. Movements may be effected by awns.

*Wind as an agent in dispersion.*—One of the simplest and most general modes of utilising wind as an agent is seen in plants which bear the fruits supported on a stalk of some length, *e.g.*, foxglove, poppy, hemlock, and many others. In most of such plants the fruit is dry, and splits open in some way or other to allow the escape of the seeds, which in such fruits are generally numerous and small. In these fruits the opening is almost always near the top, or if, as in the bluebell (*Campanula*), it is near the base, the fruit usually hangs reversed. In this way the seeds are retained in it so long as it is at rest, but when the fruits and stems are driven about by wind the seeds are thrown to some distance around. In some plants, such as the hemlock, the fruits are one-seeded, and do not split open, hut remain attached when ripe till jerked off when the plant is shaken by wind. Seeds of small size are carried off in the air, and are blown ahout like so much dust; and among cryptogams this is a very frequent mode of distribution, and the geographical range of these plants is often extremsly wide. Among phanerogams or flowering plants the seeds are seldom small enough for this, but they are frequently rendered sufficiently light hy modifications of various kinds;—in their own structure if set free from the seed-vessel, or in the carpel or outer parts of the flower in the case of one-seeded indehiscent carpels.

In orchids geuerally, and here and there among other plants (e.g., *Pyrola*, *Parnassia*, *Drosera Anglica*, &c.) the seeds are very numerous and small, and the outer coat of the the seed much wider than the inner, forming a loose bag filled only with air ; hence such seeds are very light and are easily blown about.

A number of plants have the outer coat of the seed prolonged to form a thin membranous wing, yielding the same advantage. In some (e.g., *Spergularia marginata* and *Rhinanthus crista-galli*), the wing surrounds the seed. No native Scottish plant has such a wing of large size, but in some tropical species (e.g., *Bignoniaceæ*) it reaches a breadth of over an inch. The firs and various other conifers have a large wing directed obliquely upwards and to one side; probably most persons have noticed how far these seeds are carried hy even a moderate breeze before reaching the ground. The effect may also he understood if one examines moorlands or natural pastures for some distance around a fir wood. Young fir-trees will be found to be abundant in such localities, though cropped so close to the soil in pasturage that they need to be looked for.

In other plants the seeds bear a coat of hairs over the surface (as in the cotton plant), but of this we have no conspicuous native example. Among willows and poplars, and also in the willow herhs (*Epilobium*), each seed bears a tuft of hairs at one end, and the seeds themselves are small and light, so that they are wafted on by the faintest breeze. The dispersion of the seeds from a clump of willows or of poplars is often too noticeable to have been overlooked by even the least observant.

Among one-seeded indehiscent carpels we meet with adaptations very similar to those just noticed among seeds, and also with others of a different nature, all serving the same use in the economy of the plant. Carpels are frequently so like seeds iu appearance that they are often called seeds (as in the so-called carraway seeds,

or those of the daisy, of grasses, &c.), and a careful inspection may be needed to show their true nature. The readiest test is to cut through the suspected body, in which case, if it is a carpel, the seed will be found inside it. Such carpels (*e.g.*, those mentioned above) are frequently small, but they are very rarely small enough to be carried about like dust, and equally rarely are rendered light by means of empty space in the walls of the carpels (e.g., in *Myagrum* and *Valerianella* species.) On the other hand, one-seeded carpels are often winged. The most rudimentary adaptation of this kind is seen in plants where the carpels are flattened as in *Heracleum*, without being prolonged into a noticeable wing. From this stage all intermediate forms occur up to the bilateral wing of the elm and birch and the large unilateral wing of the maples. The ash-tree also has a long wing projecting beyond the seed-bearing portion. Similar winged carpels are found in many exotic plants of different genera and orders. A rarer form of wing occurs in *Paliurus aculeatus*, in which it encircles the carpel like an umbrella about half-way between the base and the apex. In all these cases the wing of the carpel is small in, or even absent from, the flower, becoming developed only as the ripening of the seed advances.

Less frequently, very rarely indeed in British plants, the carpel becomes covered with a growth of long hairs, which form a float to support it in the air. In *Dryas octopetala* and in *Clematis* among native plants, and in various foreign species of different genera, the style, instead of falling off after the ovules are fertilised, increases much in size, and becomes converted into a float by the growth of long hairs all over it.

In many plants the outer envelopes of the flower, viz., corolla and calyx, or the flower-stalk or bract (*i.e.*, the leaf between which and the stem the flower grows out), may become or may bear the adaptation for wind-carriage. The outer envelope or calyx is the part most frequently modified. If the calyx arises from the flower-stalk below the base of the ovary, and is free from the ovary, it may become much enlarged and bladdery, so as to surround the fruit, and to leave a large empty space between, rendering the whole body light. Such an arrangement may occur in plants with a calyx of coherent sepals (e.g., *Trifolium fragiferum*), or with a calyx of free sepals, e.g., *Rumex*. In some foreign plants (e.g., *Gyrocarpus*) two or more sepals may become much enlarged so as to form apparent wings; this may be the case in superior as well as in inferior calyces.

In superior calyces, or those which arise apparently from around the top of the ovary, the modifications met with are greater than in inferior calyces, and are also more frequently met with; but, as in them, become conspicuous only as the seeds ripen. In some plants the calyx spreads out like an umbrella, or like scales or plates, which buoy the fruit up, and render its fall slower. Most *Compositæ* (dandelion, thistles, &c.) and some allied groups, e.g., *Valeriana*, have the calyx represented by the *pappus*, a spreading crown of hairs arising (as in thistles) directly around the top of the ovary, or (as in the dandelion and goat's beard) supported on a long beak that extends from the upper end of the ovary. These hairs may stand in one or in several rows, and may be simple or more or less branched. Their efficacy in floating the fruits is probably familiar to every one. In the cotton-grasses (*Eriophorum*) we meet with a similar modification in the floral envelopes. These consist of merely some slender hairs, which in the flower are quite small. As the seeds mature the hairs lengthen, and finally they become very conspicuous, forming large heads like masses of silky cotton, familiar to every one that has seen a Highland moor in summer. When the seed-like carpel breaks away the hairs are carried with it, and the whole floats away on the breeze.

The corolla or inner floral envelope is so seldom modified apart from the outer that it needs no further comment here.

In several of our native plants the flower-stalk bears hairs which elongate after the seeds are fertilised, and at last form relatively large tufts. Among the grasses *Phragmites communis* (reed) and *Avena pubescens* may be instanced. *Typha latifolia* also shows this arrangement. In such cases the flower-stalk breaks away, remaining attached to the ripe fruit.

The lime-tree or linden (*Tilia*) gives an excellent example of the bract forming the wing. The flower-stalk (bearing several flowers, and therefore also several fruits) is adherent in part of its length to the long rather narrow bract. When the seeds are ripe the bract falls off with the fruits and flower-stalk, and is a very efficient means of conveying them to some distance before reaching the ground. In the hornbeam (*Carpinus*) and hop each fruit stands sessile in the axil of a small bract which falls off with it like a wing. In many grasses the glumes or bracts fall off with the fruit, and form imperfect floats, *e.g.*, in *Holcus*, *Phalaris*, &c.

Yet other modifications adapted for this mode of conveyance of seeds are met with, but it would be tedious to dwell on them now, and, moreover, they rarely are found in Scottish plants.

*Conveyance by water* is a far less general means than by wiud, and special adaptations are rare. Of course, the seeds or fruits of any plants growiug on the side of a stream may fall into it, and may be conveyed to a considerahle distance, if light enough to float, before heing again cast on land. Of this mode of conveyance we have clear proof in the occurrence of typically alpine plants frequently here and there along our rivers in the lower grounds. But no special adaptations are needed or are met with for this method. Very few of our native plants live floating freely on the surface of the water, though in the tropics such plants are so abundant as to form floating islands, often over an acre in extent. The seeds of these plants germiuate nnder water, aud they are dispersed without special means by the movements of the plant freely on the surface of the water, carried along by winds or by currents.

Special adaptations occur iu the water-lilies, so commonly to be found iu Scottish lochs. The fruit iu both the white and the yellow water-lilies contains several spaces ranged round a ceutral column like the spaces between the spokes of a wheel. In these lie numerous seeds. In the yellow water-lilies (*Nuphar*) the outer coat of the fruits alone splits open when the seeds are ripe, aud the inner layer enclosing each of the various divisions splits away containing the seeds, and also enough air to buoy up the whole on the surface, where it floats for a time driven about hy winds or currents, till a hole forms in the wall, and seeds drop out aud sink to the bottom of the loch. There they germinate iu the mud. In the white water-lily (*Nymphœa*) the seeds are set free when the fruit splits ; hut each seed has a coat that has grown up from the funiculus or stalk loosely round it, so as to cover it, enclosing air enough to float the seed, and thus to allow of its conveyance to some distance. On the decay of this coat, and the escape of the air, the seed sinks to the hottom.

*Adaptations for conveyance attached to the bodies of animals.*—Sticky secretions very seldom form the means among our native plants; never, in fact, as regards the seeds themselves, one might say, though the seeds of *Linum* and of a few other plants become sticky when moistened. The fruits of a few show a similar quality, and the ovary of *Linnœa borealis* is said to be sticky when ripe by reason of gland hairs. In some *Labiatœ*, the calyx, which breaks away with the fruits, is sticky for the same reason.

Prickles or hooks form by far the most frequeut means for attaching the fruits to the bodies or limbs of animals. It may be said that no Scottish plants show structures of this kind on the seeds themselves; indeed, seeds so provided are rarely met with anywhere. The surface of the ovary sometimes hears many small prickles (e.g., *Ranunculus arvensis*, *Cynoglossum officinale*), or, as in some exotic genera, it may hear one or more spines or hooks of considerable size. A well-known example is the fruit of the "Wait-a-hit Thorn" of South Africa (*Harpagophytum*), with hooked branched spiues an inch long, and very strong. These fruits are said to be very injurious to sheep through sticking in their wool, and irritating the skin when the sheep lie down on them. Many Scottish plants with inferior ovaries have the outer surface of the receptacle-tube covered closely with prickles (e.g., Carrot, *Torilis*, &c.), or small sharp hooks (e.g., *Circœa*, *Galium aparine* or Cleavers, *Asperula*, *Sanicula*, &c.), which form very efficient grasping organs. In others there is only a ring (or two or three rings) of hooks round the edge below the calyx (e.g., *Agrimonia*). In the native species of *Geum*, the style elongates as the seed ripens. Near its middle there is an ahrupt bend. When the seed is ripe the part of the style beyoud this breaks away, leaviug a sharp hook, which, though small, cau take a firm grasp. In a few exotic plants the corolla of the flower remains adherent to the top of the carpel, forming sharp hard hooks as in *Tragœceros*, in which there are two such in the rayflowers. Such a modification of the corolla is not met with in any of our native plants. The flower-stalk seldom bears hooks or spines for grasping, but not rarely the bracts are so furnished. In the burdock (*Arctium Lappa*) each of the narrow bracts that form the iuvolucre ends in a small sharp hook. The whole head breaks away from the stalk, and very readily adheres to the fur or feathers of passing quadrupeds or birds, or to the clothes of passers-by. In some *Umbelliferœ* the flowerhead or inflorescence breaks off aud becomes attached to passing animals hy aid of small spines over the surface of the bracts. In many grasses (*e.g.*, barley) the glumes or bracts end in long prickly awns, which form efficient organs of attachment.

Fleshy fruits are, as a rule, specially suited for the dispersiou of the seeds by quadrupeds, or more generally by birds; and plants with fruits of this kind may frequently be found in situations such as to show that the seeds must have heen brought from a distance. As previously mentioned, the fruits are swallowed ; the seeds pass, but little, if at all, the worse, through the intestine, beiug protected usually in some way by their structure from injury in their passage, aud when discharged they germinate as readily as, or in some cases eveu more readily than, if they had uever been subjected to this treatment. The seeds suited for this mode of dispersion

are frequently protected from injury by being enclosed in a hard covering, which in some is the outer coat of the seed (*e.g.*, nutmeg), while in others it is the inner layer of the carpel (stone of cherry, &c.) Other seeds (*e.g.*, gooseberry) are enclosed in a soft jelly-like pulp, which seems to protect them.

Few Scottish plants have the seeds themselves exposed, the attraction being found in a fleshy growth, called an aril, that surrounds the seed, and is usually conspicuous in colour; but we find examples of such in the yew and the spindle tree *(Euonymus)*. Among exotic plants a frequently-quoted instance of this method is the nutmeg, the seed of which is the size of a pigeon's egg. It is covered with the fleshy mace, and is swallowed for this by large fruit-eating pigeons, and is widely dispersed by this means. At one time the Dutch tried to restrict the cultivation of nutmegs to the Banda islands, in order to retain a monopoly of them, and destroyed the trees on the other Malay islands; but their efforts were vain, as the seeds were continually conveyed to these islands from Banda by the birds.

Very commonly the walls of the carpel become fleshy in whole or in part, and remain indehiscent. Such fruits may be divided into the two groups of (a) *berries*, with the whole wall soft, enclosing numerous seeds; and (b) *drupes*, where the outer part of the wall is fleshy, but the inner layer is leathery or stony as in cherries, enclosing usually not more than two seeds, generally only one. Both groups are well represented among us. Of berries we have the gooseberry and currants, the barberry, privet, vacciniums, honeysuckle, crowberry, potato, Solomon's Seal, and various others. Of drupes we have the cherry, gean, sloe, and a few others of a similar nature. The raspberry and bramble are merely masses of small drupes crowded on a slightly-fleshy stalk. A modification of the drupe is seen in the apple, pear, rowan, and others of the genus *Pyrus*, in which the leathery carpels are sunk completely into a cuplike fleshy flower-stalk which enlarges greatly as the seeds ripen. In the hawthorn, well known to be much eaten by many of our birds, the structure is much as in *Pyrus*, only the carpels are of stony hardness. In roses the flower-stalk is hollowed out and encloses a number of small one-seeded carpels, generally mistaken for seeds. The rosehip is this flower-stalk much enlarged, fleshy, and sweet; it is very attractive to various animals. The strawberry, on the other hand, is a convex flower-stalk much enlarged, and becoming sweet and fleshy as the seeds ripen. The so-called seeds on its surface are small one-seeded carpels. They are swallowed with the edible part, and the seeds are protected by the carpels in their passage through the intestine. These are the various adaptations met with among our native plants that favour this mode of dispersion, but I may be permitted to note one or two additional parts that become fleshy in fruits of other lands. The mulberry at first glance looks not unlike a bramble, but is essentially different, being made up of a number of flowers, each consisting of a one-seeded ovary enclosed in two pairs of enlarged fleshy sepals. In figs there is what reminds us of a rose in its structure, but in the fig the hollow flower-stalk supports and envelopes a multitude of minute flowers, each one of which has a small one-seeded ovary,—the so-called seed of the fig. The flower-stalk is the eatable part, and makes up the great mass of the fruit.

In a few plants the bracts become fleshy, but this is rarely the case, and I am not aware of any example of this structure among Scottish species. The pine-apple *(Ananassa sativa)* shows it well, and its appearance is probably familiar to most persons now-a-days.

Elastic dehiscence of fruits frequently occurs in certain orders of plants, notably among the *Leguminosæ* and *Geraniaceæ*. The mode of dehiscence of the former forces itself on one's notice, to the ear at least, in the fine sunny days of autumn on any piece of ground overgrown with broom or whins. The sharp reports of the bursting pods are often to be heard on all sides in such circumstances. When the seeds are ripe in the fruits of this order, there are two lines from tip to base of the pod, viz., its two edges, where the structure renders them most liable to give way. In dry sunny weather some moisture evaporates, and contraction of the walls of the pod follows. If this goes beyond a certain limit, it becomes too great for the resistance offered at these lines, which suddenly give way, the two halves burst apart, and the jerk throws out the seeds often to a distance of several inches, or even feet. In the wild geraniums each carpel usually contains only one seed, but generally five carpels are present in each flower. The ovaries are closely adherent in the flower to the base of a central column, while their long styles are adherent to the column nearly to their tips. When the seed is ripe, in dry weather, each ovary separates suddenly from its attachment, while the style remains adherent to the column, and thus throws the seed, as if from a sling, to some distance. In the nearly-allied wood-sorrel *(Oxalis)* the seed is thrown out by a different mechanism. The fruit is a capsule that, when the seed is ripe, bursts into five parts in which the seeds lie. Each seed has an outer coat or arillus in addition to the usual coats, and this arillus is very elastic. When the fruit bursts the fleshy arillus contracts through

loss of moisture, hursts, and by its elasticity propels the seed, as one propels a pea from between the finger and thumb. Still another mode of elastic dehiscence is met with in one or two plants allied to the cucumber, viz., *Elaterium*, or "squirting cucumber." The fruit is a fleshy oval body with elastic walls in a constant state of teusion. The seeds lie imbedded iu a mass of pulp in its interior. When they are ripe the fruit drops off its stalk, leaving au opening at the point of attachment, and through this opening the seeds aud pulp are shot out to a distance of several feet by the sudden contraction of the elastic walls. Of this kiud of dehiscence we have no example among native plants, and I must apologise for digressing to mention it.

Lastly, we find among grasses some in which the fruits are able to move over the surface of the ground, or even to burrow into it to sufficient depth to cover themselves. These movements result from the nature of the awns, which remain attached to the glumes or bracts, which break away aud remain as a covering to the ovary. The awns are bent or twisted, and have the peculiarity of being very ready to absorb or to give off moisture, the bend or spiral altering its dimensions with every variation in the amount of moisture. Every such change of position moves the ovary, but, owing to fine prominences on the glumes, &c., they can move ouly in one direction;—thus every movement propels it forward, and in this way the seeds may be pretty widely distributed after some time.

As formerly meutioned, frequently the same methods of distribution are found in plants wide apart in structure, while in other plants nearly allied to one another the methods are very distinct, the adaptations being suited to very different agencies. And you will probably readily understand that such resemblances are no proof of genetic relationship, and such differences no proof of distance apart, but that they depend ou environment, and on the conditions best suited for the welfare of the various species of plants. Though this paper is already a long one, I may perhaps be permitted to instance more fully a few examples of resemhlauces aud of differences in this view. Of resemhlances we meet with the elongated plumose style, serving as a float, in *Clematis* and in *Anemone pulsatilla* among *Ranunculaceæ*, and again in *Dryas octopetala* and *Geum montanum* among *Rosaceæ*. Seeds with an unilateral wing occur in *Coniferæ* (firs, &c.), iu the mahogany tree (*Swietenia*), in *Proteaceæ* (*Banksia*, &c.), and various others; seeds surrounded with a wing in *Bignoniaceæ*, *Caryophyllaceæ* (*Spergularia*, *Dianthus*, &c.), *Cruciferæ* (*Alyssum*, &c.), *Liliaceæ*, (*Lilium*, &c.), and others; hairy seeds in *Malvaceæ* (*Gossypium*), *Sterculiaceæ* (*Bombax*); and seeds bearing a tuft of hairs in *Epilobium*, in *Asclepiadaceæ*, *Salicaceæ*, and various others; winged fruits are present in *Fraxinus*, *Ulmus*, *Betula*, *Ptelea*, *Angelica*, *Acer*, *Banisteria*, and many other genera belongiug to different orders. Examples of such resemblances in widely-different plants might he multiplied indefinitely, but these may suffice.

Turning now to the various modes of distribution met with in the same natural order, and even in the same genus, these are at times very different. In *Onagraceæ*, we find (1) *Epilobium*, with capsular fruit enclosing very uumerous small seeds, each provided with a tuft of hairs. (2) *Fuchsia*, nearly allied, but with the fruit a berry, and no hairs on the seeds. (3) *Circæa*, with a small iudehiscent fruit (with one or two seeds), covered with small hooked prickles for grasping. Among *Rosaceæ* are numerous and very various modes of distribution. Looking at the arrangement of the genera in any flora of Scotland, we find that (1) *Prunus* has the fruits and drupes distributed chiefly by birds swallowing them, and voiding the seeds enclosed in the stone (*e.g.*, cherry and sloe.) (2) *Spiræa* has fruits that open when ripe (follicles), but require to have the seeds shaken out by action of wind on the stems. (3) *Agrimonia* has one or few seedlike indehiscent carpels enclosed in a tubular flower-stalk which bears round its edge small hooks; this part breaking off, with the ripe carpels enclosed, the hooks serve for grasping. (4) *Alchemilla* and *Potentilla*, no special adaptations. (5) *Fragaria*—strawberry—has the flower-stalk enlarged, fleshy, aud convex, with many seed-like carpels over its surface. The large stalk is swallowed bearing the carpels, which are thus distributed when voided hy birds. (6) *Rubus*—raspberry, bramble, &c.—the fruit is a mass of small drupes like miniature cherries, and is distributed in like manner hy birds. (7) *Geum*, as far as concerns our native species, has the style provided in the middle with a bend, which forms a hook for graspiug when the apical half falls off, as it does when the seed is uearly ripe. The carpels are small. (8) *Dryas octopetala* and *Geum montanum* have the style elougated and hairy, to float the seedlike indehiscent carpel. (9) *Rosa* has numerous seedlike carpels enclosed in a hollow flower-stalk, which becomes eularged and fleshy, and is eaten by animals along with the euclosed carpels, which are thus distributed. (10) *Cratægus* (hawthorn) and *Pyrus* (apple, pear, rowan, service berry, &c.) have the stony or leathery carpels enclosed in a fleshy flower-stalk so closely that it seems to form a part of the carpels. This is eaten by animals, and the seeds, alone or enclosed in the carpels, are distributed, when voided, to some distance from the

tree on which they grew. Thus among our native *Rosaceæ* we meet with nine different adaptations for distribution of the seeds;—five specially suited for passing through the bodies of animals, two for conveyance attached to fur or feathers, and two for distribution by wind. Similar facts may be elicited by an examination of other natural orders, but need not be dwelt on at present.

In conclusion, it may not be amiss to point out that the various adaptations occur only under such conditions as are directly useful and beneficial to the plant in promoting the wide dispersion of its seeds, either alone, or still enclosed in the ovary. Modifications in the seeds themselves occur only in such fruits as open to allow the escape of the seeds. It is only in these that we find loose seed-coats, or wings, or hair-tufts; very rarely are hooks or spines found on seeds, as they would apparently be in the way in the ovary. Again, modifications in the ovary, suiting it for conveyance by wind or attached to bodies of animals, are found only in ovaries that contain one or two seeds, and that do not open, but themselves break off from the parent plant, and are dispersed as if they were seeds. In like manner the parts eaten by animals, whether an arillus, or the ovary itself, or some outer part of flower or flower-stalk, always inclose the seed or seeds in such a way as to ensure the great likelihood of their being swallowed without injury. Modifications of the envelopes, of the flower-stalk, or of the bract, suited for dispersion by wind, or by attachment to the bodies of animals, are found only in those cases in which the part modified breaks off from the plant, and continues attached to the ovary.

From an examination of the structures of plants in view of the dispersion of seeds, we are warranted in believing that we may succeed in understanding something of the way in which specialisation of parts to ends is brought about to meet the conditions of healthy vitality, while we find here as everywhere economy of force, and adaptations of means to ends ungrudgingly, but with no trace of waste of power.

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MARCH 2nd, 1882.

## *ANNUAL MEETING.*

Dr GEIKIE, F.R.S., President, in the Chair.

### NEW MEMBERS.

The following new members were unanimously elected:—Mr Wm. Mair, 13 Marshall Place; Mr David Marshall, Inchview Villa, Balhousie; Mr Wm. Martin, Aberuthven; Mr David M'Lagan, Burton Place, Nelson Street; Mr Robert M. Kippen, Marshall Place; Mr O. S. Leitch; Dr Morrison, Dunning; Mr David Macgregor; Mr A. Davidson, York Place; Mr R. Hay Robertson, jun.; Mr Thos. Wyllie, 7 George Street; Mr James Fisher, 7 George Street; Mr John Henderson, sen.; Mr James M'Nicoll, High Street; Mr Charles Grego; Mr W. A. Paterson, Croft House, Craigie; Mr J. Martin White (Spring Grove, Dundee) of Balruddery; Mr J. M. Kirk, Athole Street; Mr Wm. Robertson, High Street.

The following were nominated for election at next meeting:—Captain D. M. Smythe, yr. of Methven; Mr Basil Brooke, Cardney, Dunkeld; Miss Stewart, Craigard; Mr Wm. Keillor, Lochton; Mr Wm. Honey, Bridgend; and Mr Alex. Macdonald, George Street.

### DONATIONS.

The following donations were intimated:—From Mr Forbes, Kilgraston—one water rail; from Mr John Robertson, Auchterarder—one stoat; from Mr Stewart, Logiealmond—one snow bunting; from Mr James Scott, Methven Castle—one teal duck; from Mr J. Nelson, 6 Wellington Street, Dundee—one scaup duck; from Sir Robert Menzies, Castle Menzies—two jays; from Mr James Dow, Gask—one ring ouzel; from Mr William Frazer, Innergeldie—one ptarmigan; from Mr W. M'Lean, Murie House, Errol—one great black-backed gull; from Mr John M'Donald, Rannoch Lodge—three stoats, three missel thrushes, three chaffinches, three greenfinches, three blue tits, two coletits, two gold-crested wrens, one creeper, and one shrew; from Mr John M'Laren, Inchmartine—one pink-footed goose; from Col. Drummond Hay, Seggieden—three starlings; from Capt. M'Dougall, Orchill—one long-eared owl, one stoat, three crossbills, two yellow-hammers, two cole-tits, one greenfinch, and one house-sparrow; from Mr M'Lean, Murie House, Errol—one sparrow-hawk, and one speckled blackbird; from Mr James Keay, Murthly—two golden plovers; from Mr Cornwall, Pitcairns, Dunning—one dipper; from Mrs Robertson of Struan—one stoat; from Mr M'Donald, Rannoch Lodge—one common gull, two pairs bullfinches, one snow bunting, one creeper, and one pair crested wrens; from Mr Robertson, Blairhoyle—two stoats; from Mr Cuthill, Meigle—one sparrow-hawk, one curlew, one golden plover, and one common gull; from Mr Crerar, Faskally—two dippers, and one stoat; from Mrs Robertson of Struan—logs of Rannoch pine, birch, and aspen; from Sir Robert Moncreiffe—section of wood of sweet chestnut.

## REPORT OF THE COUNCIL.

The Council, in presenting the FIFTEENTH ANNUAL REPORT, has much pleasure in congratulating the members on the increasing prosperity of the Society.

During the past session five ordinary meetings were held, the average attendance at which was 26, being an increase of 9 over the average of previous session. As the Society is now in possession of a large and commodious meeting-room, it is hoped that the average will be yet higher. The largest atteudance was 42. At these meetings 9 papers were read, the number of authors being 8.

During the past year, 76 new ordinary members, and 1 corresponding and 1 honorary member, have been added to the roll, being about 70 more than the previous year.

Four long excursions,—namely, to Abernethy, Lochearnhead, Farragon, and Pitroddie,—and several short excursions, were made during the summer, and resulted iu au increased knowledge of the natural history of the county.

The past session has been in several respects a momentous one in the history of the Society. The most important event of the year was the entry of the Society into possession of the commodious building erected for it by the Committee of the Moncreiffe Memorial Museum Fuud, which building was formally handed over to the Society in October last. Another importaut event was the Bazaar held in December in aid of the funds of the Society, and which, while resultiug in drawing nearly £1600, testified the warm interest takeu by all classes of the community in the objects of the Society. The Couucil desires to take this opportunity of placing on record the gratitude of the Society to the stallholders, and all others who contributed to the great success of the Bazaar.

Another event to which your Council wishes to allude is the success that has attended the Gilchrist Course of Scientific Lectures, a gratifying feature of which has been the co-operation, in conducting them, of the Perth Literary and Antiquariau Society.

Schemes for the utilization, for the purposes of the Society, of the new premises have been frequently and seriously considered by your Council, and arrangements have now beeu completed for throwing open the rooms to members at stated hours on almost every week-day. These hours are as follows:—Monday, 10 A.M. to 3 P.M.; Tuesday, 7 P.M. to 10 P.M.; Thursday, 7 P.M. to 10 P.M.; Friday, 10 A.M. to 3 P.M.; Saturday. 3 P.M. to 7 P.M. The foregoing are the stated hours of meetings, but the buildings will be open every day from 10 A.M. to 8 P.M.

## REPORT OF THE LIBRARIAN.

BY MR GEORGE YOUNG.

As since the Society came into possession of its new premises scarcely enough time has elapsed to permit of the uew Library arraugements being entirely completed, the Librariau has merely to report that steps are being takeu to put the library in a thoroughly effective working condition. As alluded to in former reports, the want of accommodation in the Society's temporary premises was very prejudicial to the Library, and many volumes have gone astray, and it is to be feared will not now be recovered. Should any member have books belougiug to the Society in his possession, he is requested to return them without delay, in order that the new arrangements may be carried out. A list of the missing books will be found on the notice-board in the Library. As the Society has now ample accommodation, a considerable number of books on all branches of natural history are in course of being procured, and it is purposed that the Library shall in future contain two departments—one for works of reference, the other for books which may be lent out. So soon as the new arrangements are completed, intimation of them will be put up on the notice-board.

## REPORT OF THE TREASURER.

The Treasurer (Mr John Macgregor) submitted a statement of the accounts for the past year, from which it appeared that the amount of income was £82 16s 3d, and expenditure £55 2s 6d, leaving a balance on hand of £27 13s 9d. The Treasurer also reported that there were in all 288 members on the roll, 5 being associate aud 17 corresponding members. 76 new members had joined the Society during the year.

## REPORT OF THE CURATOR.

By Colonel DRUMMOND HAY, C.M.Z.S.

In my report last year, I was enabled to express the pleasure of the Society's possession, for the first time, of a proper museum building, not, however, then quite completed. We were rather iu the dark at the time as to how funds would be forthcoming for thoroughly furnishing the same with suitable cases, drawers, and other dust-proof contrivances for the specimens; all this requiring no small outlay of capital. Since then the Society has made a trip to Switzerland, *i.e.*, not in the *real*, certainly in the *ideal*, and come back, as I have uo doubt you will have been informed, with sufficient funds to enable the Committee to go on with the work. The latter, losing no time, proceeded at once to make itself acquainted with the most approved principles as to fittings and furnishings adopted in other museums, and for that purpose made an inspection of the well-appointed museum in the Albert Institute at Dundee, and thereafter fixed on certain plans, with improvements of its own, which are uow in process of being carried out; and I have much satisfaction in informing you, that the cases, which are of superior make, are in a very advanced state, and will soon be completed.

The Museum will consist of as complete a collection as possible, so as to represeut the entire natural history of Perthshire, comprising the whole of the zoology, botany, and geology of the county, and the basin of the Tay, which will occupy the greater part. Four table cases will contaiu selections from the chief groups in the animal, vegetable, and mineral kingdoms, as an index or type collection to illustrate natural history in general.

A meeting of the Working Committee has been held weekly, aud steps have beeu taken by it to solicit the assistance of proprietors and others throughout the couuty, for the purpose of procuring specimeus.

A taxidermist has beeu appointed, aud, thanks to numerous promises of help in all directions, it is to be hoped that a large

collection will soon be formed, in additiou to what the Society is already in possession of, but it should be distinctly borne in mind, that help is being asked (and we need all we cau get) not so much for the benefit of the Society as for the advantage of the whole community;—it is, therefore, of the greatest importance that as perfect a collection as possible of the local natural history be placed at the service of the public; and I can only hope that a thorough interest will be taken in the matter throughout the whole county in promotion of so desirable an object.

In conclusion, I may say that the arrangement of specimens will be carried out as speedily as possible; but as the work is great, some time must elapse before the Museum can be opened to the public. The more assistance, therefore, we receive, so much the sooner is it likely that the Museum can be opened.

### REPORT OF THE EDITOR.

By Dr BUCHANAN WHITE, F.L.S.

During the past year the only work published by the Society has been Part I. of the first volume of its "Proceedings." This was to a certain extent an experiment, which so far has proved successful. The "Flora of Perthshire" is still unpublished, but this is rather a matter for congratulation than regret, as some very important information regarding Perthshire plants has been acquired during the past year.

On the motion of Sheriff BARCLAY, seconded by Sir ROBERT MONCREIFFE, Bart., the reports were unanimously adopted.

### ELECTION OF COUNCIL FOR 1882-83.

The following members were unanimously elected as the Council for the session 1882-83:—

Colonel H. M. DRUMMOND HAY, C.M.Z.S., of Seggieden, *President.*

ROBERT PULLAR, Esq., F.R.S.E.
Sir R. D. MONCREIFFE of Moncreiffe, Bart.
JOHN STEWART, Esq.
MAGNUS JACKSON, Esq., F.S.A.Sc.
} *Vice-Presidents.*

JOHN YOUNG, Esq., C.E., Tay Street, *Secretary.*
JOHN MACGREGOR, Esq., Post Office, *Treasurer.*
Colonel H. M. DRUMMOND HAY, C.M.Z.S., of Seggieden, *Curator.*
JAMES COATES, Esq., *Librarian.*
F. BUCHANAN WHITE, M.D., F.L.S., *Editor.*
P. D. MALLOCH, Esq.
JOHN DAWSON, Esq.
S. T. ELLISON, Esq.

And *(ex-officio)* the Trustees of the Society,
Colonel DRUMMOND HAY,
Dr BUCHANAN WHITE,
R. PULLAR, Esq., and
A. COATES, Esq.

The PRESIDENT then delivered his Annual Address, as follows:—

Upon looking over the records of this Society, I find that your Presidents have almost invariably commenced their annual addresses by congratulating the members upon the satisfactory and gratifying character of the reports presented by the officebearers of the Society. I observe, however, that these congratulations have been not unmingled with expressions of dissatisfaction,—the most common—indeed, I may say, the never-failing—subject of distressful comment having been the "cribb'd, cabin'd, coffin'd, and confined" room, with its malodorous atmosphere, in which until lately we were wont to assemble. To-day we are in the happy position of having listened to reports in which we have heard nothing that is not gratifying and full of promise for the future. When my last annual address was given I certainly expected that in another year I should speak to you in a new place, but I hardly anticipated that the final accomplishment of our scheme would be so complete and satisfactory as it has proved. It is a very great matter to begin our new career without one penny of debt upon our heads;—it is still more gratifying to have got together the nucleus of a little capital, which I hope we shall be able to increase year by year. For a long time to come our utmost endeavours must be used towards the filling of our museum-cases with local and typical collections, and I might well employ the present occasion with some words of help and encouragement in this work were it not that our much-esteemed editor has recently gone into the matter so fully, and with such admirable common-sense. He has put the case so ably before you that I need do no more than ask you to give what he has said your most careful attention. In casting about in my mind for some other suitable topic upon which to address you to-day, it occurred to me that perhaps it might not be out of place (now that our Society is entering upon a new phase of its existence), were I to dwell for a little on the aims and ends of Natural Science studies. The subject is old and perhaps somewhat threadbare to many of you, and probably I shall say nothing which has not been heard before, or which you yourselves have not already thought and said; nevertheless, it seems not unmeet that, in our present circumstances, when so many new members have joined us, we should be reminded of what are acknowledged to be our duties and privileges as students of science. The strides with which science has advanced in recent years, and the rapidity with which schools, classes, societies, and institutions devoted to science-studies have sprung up almost everywhere throughout the country, are among the

most remarkable phenomena of our day. So rapid, indeed, has been that progress and diffusion of knowledge, that it is somewhat hard for a middle-aged person to realise the state of matters which existed in our midst only some 20 or 30 years ago. Many new lines of investigation have been instituted: I might almost say that even new sciences have budded and developed into great trees, with widespreading roots and branches, within that short space of time. The old things are fast passing away, and it is well it should be so, although I am conservative enough to believe that some of these old things have been too readily flung aside, and that by and by it will be found necessary to seek them out again, in order to restore them to a place of honour in our schemes and systems of knowledge.

If you wish to get an adequate notion of the changes which have supervened in the study of Natural Science within comparatively few years, you would do well to visit one of those local museums, which are still to be met with in regions upon which the newer lights of science have not yet shone. In such a collection you shall find an odd mixture of curiosities of all kinds—natural and artificial. In one place you observe cases of birds,—many of them perched in impossible attitudes upon unknown trees,—or a motley array of stuffed skins of mammals, which often bear as much resemblance to the animals whose hides they are, as the red lions and blue bears of the publican's signboard do to their supposed prototypes. Then, you shall encounter compartments filled with shells, native and foreign,—marine, freshwater, and land-species often enough commingled,—which have evidently been collected and preserved for their beauty, or it may be for their bizarre appearance. Fossils and minerals are seldom quite forgotten,—the showiest specimens coming well into view, and the dingier and less striking ones being relegated to obscure corners. But the most highly-prized gems of the collection, to which the curator will hardly fail to draw your attention, are the complete dress of a Red Indian war-chief, a New Zealander's club, a mandarin's dress-coat, an Egyptian mummy, and perhaps a two-headed puppy-dog. Such a collection, I think, is somewhat typical, and represents well enough the kind of notions of Natural Science which were entertained generally some 30 or 40 years ago by most intelligent people, save the few who had specially devoted themselves to Natural Science pursuits. Museums were considered mere receptacles for every kind of curio and oddity,—places of amusement seldom visited by the townsfolk themselves, but resolutely gaped through by droves of rustic lads and lasses on fair-days and other high festivals. Now visit any one of the Natural History Museums in our larger cities, and what a contrast do we encounter. In such museums we are taught while we admire, and even the most ignorant of us begins to perceive something of the wonderful adaptations and harmonies of Nature. We get glimpses of the life-histories of great groups and classes of animals and plants, and learn that all the myriad hosts of living things have been fashioned by the Creator according to definite types,—for the study of which we may find ample materials in the fauna and flora of our own district.

I have spoken of this contrast between the museums of the past and present, not to evoke a smile of superiority on our part at the expense of our worthy fathers and grandfathers, but because I believe that the crude notions which gave birth and being to the museums of the past are still widely diffused amongst us, and that, if they do not crystallize out in the quaint form I have described, they nevertheless tend to leaven public opinion on the subject of Natural Science studies. The founders of our old museums were embued with the laudable belief, that it was well that we should know more of Nature and Nature's productions than was to be gathered in our every-day walks at home. And the collections they formed did good service by enabling us to realize, in however small a degree, some of the all-important facts relating to the geographical distribution of animals and plants. It was something to have seen and handled shells and corals which had been picked up on the coasts of remote islands in the Pacific Ocean,—something to have learned that the common forms of our own shores differed so much from those of more distant regions. Indeed, to a well-informed naturalist, some of those ancient dusty collections are not without a certain subtle charm. The striking contrasts which the contents of each case present, will often suggest many and diverse topics of reflection, and set him musing on some of the most interesting results and enchanting generalizations which have been obtained by the combined labours of generations of naturalists. For the moment, a kind of spell is upon the studious observer,—evoking occult musings and reflections, like those wonderful chords and snatches of weird melody which a harp gives out at the touch of wandering winds. But this, I need hardly say, was not the educative result contemplated by the founders of our old museums. These worthy men were, as a rule, mere collectors of curiosities, for which they hunted everywhere. Hence all was fish that came into their net,—it being sufficient if the object secured had rarity to commend it. In their opinion, therefore, the chief occupation and aim of a naturalist was the collection of rare specimens. The common plants and animals of a

district were of no use, they considered, for museum purposes. "What !" they might have replied, had it been suggested to them to include such objects in their collections,—"What! stuff our rooms with thistles and grasses, white butterflies and sparrows, rabbits and cats,—which one may see any day for one's self in the open air! Do you suppose that any one will pay for admission to look at objects so familiar as these?"

Now, I am not sure that such an exclamation may not have been heard by some of us who are here to-day. Unless my ears deceived me, I surely have listened to something very like it much oftener than once, and certainly at a much more recent date than even twenty years ago. In fact, there is good reason to believe that the views with which I have supposed the originators of our old museums to have been imbued, still obtain among many intelligent and otherwise well-educated people. A somewhat general impression still prevails that a naturalist is merely a collector of specimens which he dubs with jaw-breaking names, and classifies and arranges according to some mysterious plan; and the collection so formed is to many people just about as interesting and intelligible as a dictionary of terms with the meanings left out. Now, it is quite true that there are collectors who are that and nothing more. I have seen special collections in which the objects were all carefully named and arranged, but of which the ardent and enthusiastic collector really knew little more than the half-interested folk to whom he exhibited his treasures. And I daresay most of you have known men with a mania for collecting books,—few of which they had ever read, and many of which were in languages they did not understand. This mania for collecting is, therefore, not confined to pseudo-naturalists, but is one which we see in many different kinds of people, —some of whom employ the shining hour in accumulating vast heaps of used postage-stamps,—or in filling box after box with old orange-skins,—or in gathering hotel-bills, railway-station labels, &c.

To be a collector of specimens illustrative of Natural History is, therefore, not necessarily to be a naturalist any more than the fact of a man's bookshelves being loaded with the literature of all countries is a proof that the man himself is an accomplished scholar. But it seldom happens that a true naturalist is not also more or less of a collector;—and the private collections formed by such students of Nature are as diverse in character as the individual minds of the naturalists themselves. For each, as his knowledge increases, must become more and more of a specialist,—not, let us hope, a mere one-idea'd man,—who has eyes and ears for nothing save one particular branch or line of study,—but a philosophical specialist, whose mind is open to light from all quarters in the hope of being able to see his own road more clearly, and of throwing back light from his own lamp to illuminate the paths of his fellow-students in adjacent fields of research. It is largely owing to this division of labour that so much has been accomplished by scientific men within so comparatively short a period. And doubtless as years advance and knowledge continues to increase, it will become more and more necessary for those who wish to do original work to restrict their attention to more or less limited spheres of labour. And herein, as it seems to me, lurk certain dangers which will have to be guarded against. For it is to be feared that as our work becomes more narrowly specialized, our sympathies with, and consequently our knowledge of, what is being done by others will become narrow in proportion. This tendency we must strenuously fight against, if we would not descend to the level of mere makers of pin-heads. By all means let us be specialists, but at the sametime may we devote no inconsiderable portion of our time towards the study of collateral subjects. And that we may do so intelligently, and with a view to increase our knowledge, and so to broaden our sympathies for all departments of Natural Science study, we ought to form as honest an estimate as we can of the relative importance of our own work. And this we can best do by keeping prominently before our eye what are the true aims and ends of the sciences which we are doing our utmost to advance.

Now, when we take such a science as zoology, we find that it means much more to us than it did to our immediate predecessors. Zoology is not concerned merely with cataloguing the various species of animals which are met with throughout the world, and of collecting and preserving as many specimens of these as can be procured. Neither is its sole aim and end to acquire an adequate knowledge of how all these multitudinous hosts play their parts in the great drama of life. It must likewise take account of the anatomical structure of organisms, and be able to tell us how the various tissues are built up. In short, nothing connected with the origin and development of forms must be neglected. Aided by the microscope, the biologist has been able within only a few years to revolutionise much of the sciences of zoology and botany. The study of embryology has thrown a flood of light upon life-history, and enabled us to trace organic connections between forms which in their adult state seem wide as the poles asunder. It is gradually being demonstrated that all the myriad forms of animal life have genetic relations which bind together into one great family not only the

living species of to-day, but all the vast multitudes of extinct creatures which have long since vanished for ever from the world. More than this, as observations extend, that vague and indistinct line of demarcation which at one time was thought to separate the animal and vegetable kingdoms, becomes more indistinct than ever, and indeed has been shown to have really no existence — the two kingdoms merge, as it were, the one into the other.

But even after we have ascertained all that is known of the origin and development of species—of the structure of organisms—of their varied modes of life—of their geographical distribution,—we have not come to the limits of our science. There still remains many most interesting subjects of inquiry which are intimately connected with the life-history of organisms. How has the present geographical distribution of animals and plants come about? What does it mean? Here the biologist trenches upon the domains of the geologist—another proof of the unity of Nature. We soon discover that just as the roots of the great genealogical tree of life strike deep into the abysses of the past, so are our present lands and oceans only reminiscences, as it were, of other lands and waters which were the busy scenes of life ages and ages ago. The present distribution of animals and plants throughout our globe is eloquent not only of former geographical changes, but of great climatic vicissitudes. The botanist finds that in Northern Scandinavia the low grounds are clothed with certain plants which, as he travels southward, gradually disappear, and are replaced by other forms, until long before he reaches Middle Europe the last trace of the peculiar flora I refer to has vanished from the low-lying tracts. But when he leaves those low grounds and ascends the mountains, he again encounters his lost Scandinavian friends flourishing vigorously up to the limits of perennial snow. How, he asks, did these curious colonies of Scandinavian plants find their way into the mountain recesses of the Alps and other high ranges in Middle and Southern Europe? It seems at first a hard riddle to read. But the geologist gives a simple solution of the problem. He tells the botanist that at one time the climate of Europe was so cold that these Scandinavian forms were forced to retreat from the high latitudes which they now affect, and to take up their quarters upon the low grounds of Germany, where their remains occur underneath ancient peat-bogs. But when eventually those cold conditions began to pass away, then the arctic plants gradually vanished from the low grounds of Middle Europe,—migrating northwards into Scandinavia, and spreading up contiguous mountain-slopes, like the Harz, the Carpathians, the Alps, the Grampians, &c., at whose higher levels they still flourish as living memorials of the old ice age of Europe. Then, again, the botanist and zoologist know that many of the plants and animals of Britain are common to similar latitudes on the Continent. How is this to be explained? It is obvious that a very large proportion of our species could only have entered our area at a time when there was land-connection between us and the Continent; and this surmise is abundantly borne out by many collateral facts which have been brought to light by geographical investigations.

You see, then, that the aims and ends of Natural History are very far from being restricted to the mere collection of specimens, however necessary and important that may be for the purposes of study. Natural History is, in short, the history of the origin and development of extinct and living plants and animals, and of that solid crust upon which those myriad forms have lived and moved and had their being. When we once fairly appreciate this philosophical mode of viewing the Natural Sciences, we ought to run little danger of becoming mere plodding specialists. We shall have our minds elevated and our sympathies enlarged, with the certain result that our own special work will gain alike in interest and importance. By dwelling often upon the wider bearings of a Science, we shall quicken the imaginative faculty, and thereby sharpen our powers of observation, and direct these more readily into paths that will give promise of discoveries.

I have said thus much of the broader aspects of Natural Science studies certainly not to discourage anyone in his special pursuits. That would be a great misfortune, which no one should regret more than myself. It cannot, I think, be too strongly impressed upon young students of science that if they ever wish to add a single stone to the Temple of Knowledge, they must take up a more or less limited field in which to labour with all their might. It is only the hard and laborious and careful observers who attain to any reputation as generalizers. But I have often thought that many specialists would have given us more and better work if they had not allowed themselves to become cramped and narrowed by continuing too long in one rut or groove. They dig so deep that they get into a hole out of which they seldom think of climbing just to take a look round at what others are doing, and to note how the work in general is progressing. This is no imaginary danger. At the present time, for example, the interesting science of embryology, for a long time comparatively neglected, employs a large proportion of working naturalists, whose combined labours have, as I have already remarked, revolutionized the study of biology. Everyone must admit the magnificence of the results which have been attained, and which are still steadily being increased.

But one cannot at the same time help regretting that other not less interesting departments of Natural Science are not so generally cultivated. There are very few zoologists, and still fewer botanists, who seem to take much interest in questions relating to the origins of the present geographical distribution of living things. And yet such questions are big with the promise of great discoveries. But, for the present, investigators are too much enamoured of other studies to give much attention to them. Now, the members of such Societies as this might do good service by carefully working up the subject in all its details, and thus by-and-bye the abundance of material collected would doubtless attract the attention of philosophical naturalists to a subject which hardly yields to any other, either in interest or importance. Many of us have neither the time, the opportunity, nor the means and appliances, for carrying on the researches which are most in vogue at present, but each of us might be able to do something in the direction I have indicated.

I have said nothing about the utilitarian results to be derived from a study of Natural Science,—although much might be said upon such a subject, which, notwithstanding the "pooh-pooh" of some very superior persons, is yet a most important one to each and all of us. But if I pass it by it is simply because I believe the usefulness of such studies is already generally recognised. I cannot, however, close my remarks without adding a few words on the usefulness of natural science as a means of self-culture. I suppose even the busiest of us who are engaged in professional and commercial pursuits have yet now and again leisure hours which we may devote to other purposes than eating, drinking, and sleeping. A portion of that leisure time a wise man will employ in some healthy relaxation—what does he do with the remainder? Is it utilised in self-culture or simply frittered away? Some will tell you that they occupy such leisure minutes in reading. So far good: but, let us ask, is there any method in the reading? I suppose there never was an age in which there were more books to read or more books read than the present. There is a very wide diffusion of knowledge of all kinds: but, unfortunately, the depth of that knowledge is by no means proportioned to its width. So that, paradoxical as it may seem, the very abundance of our literature tends to produce superficiality and shallowness. Our magazines, excellent as many of these are, have yet not a little to answer for in breeding up a race of half-informed and therefore voluble dogmatic talkers, who are among the most obnoxious bores one meets with. The object of many of these publications is doubtless laudable,—it being the obvious desire of not a few popular writers to kindle an interest in certain subjects which shall lead the reader to go more deeply into them for himself. It would be well if this valuable result were always or even most frequently attained. But one may be excused for doubting if such is the case, when one finds that the deluge of talk seems ever on the increase. That we may not unnecessarily add to this volume of empty sound, it would be well to limit our course of reading, more or less, to some special subject,—something in which we are interested, and all the outs and ins of which we desire to became acquainted with. Such a method, honestly pursued, will eventually give us a firm grasp of at least one subject or class of subjects, and enable us to take reasonable views and to form justifiable opinions,—the working-out of which in our own minds will do us infinitely more good than if we had applied ourselves like so many sponges to soak up all the ideas and notions of other men upon half-a-hundred different branches of human knowledge. For such purposes of self-culture, any one of the Natural Sciences is admirably adapted. The assiduous cultivation of any one of these will quicken the observing faculty, sharpen the reasoning powers, and expand the imagination. An old quarryman, who had long studied geology, once made a remark to me, the truth of which will be recognised by every votary of Natural Science:—"Man, it just keeps a body aye young." That is the fact, and in this you have an explanation of the circumstance that those who have made a hobby of science are invariably cheerful, and preserve a kind of youthful lightness and brightness to the end. And, surely, in an age when the rush and crush of life becomes harder and harder to bear,—when the air is filled with doubts and questionings, which in the nature of things must ever remain unsolved and unanswered,—when the fever of politics increases in fervour,—when the simple life that our fathers led seems like a pleasant dream which in our days can hardly be realised,—it is something to be able to escape from all the dust and din, the fret and fever, to commune with serene Nature,—to drink of her pleasant fountains, and listen to the wonderful music she discourses,—to read the story of Creation as the hand of God himself has traced it in his living creatures,—to ponder upon the mighty past with its manifold changes,—and to realise the nothingness of all those little troubles that wear and fret and eat the heart out of so many of our fellow-pilgrims. Do not suppose that this ready mode of escape from petty cant and care is open only to profound experts in science. Nature is a beneficent mother, who has a kindly smile for each of her children. The youngest of her students cannot fail to come under her charm, and to have his life sweetened and brightened for him by her subtle influence. Let no begin-

ner be discouraged by the vastness of the science which he desires to cultivate. Let him reflect that not by the thoughtful labour of one or two but of many minds has the Temple of Science grown to its present dimensions. And there is no one who need despair of becoming moderately well-acquainted with its general outline, and deeply versed in some particular portion of the great structure. All that is required are method and perseverance. Do not attempt too much at first. Select some special branch of inquiry, and work at that with all diligence. The future of the earnest and honest student will take care of itself.

But I have detained you long enough with these somewhat rambling and disjointed remarks. I should be well pleased, however, if anything I have said could induce some of the younger members to become workers as well as listeners. For my own part, I never cease to bless the day when I first turned my thoughts to the study of Nature. Indeed, I cannot realise what life is with those who have no intellectual hobby. So long as youth endures, indeed, the world will not cease to be attractive. But when the lightness is passing away, the busy man ceases by and by to find any solace in the idle amusements that once occupied his vacant hours. Release him ere long from his daily labour in the counting-house or mart, and very soon he begins to break up and go to pieces. But if he should have had the good fortune to have inclined his ears early to the teaching of Nature, he has resources within himself that will keep his heart green and his brain actively employed to the last, There are comparatively few who can devote all their life to the study of science, but I feel persuaded there is not one who cannot if he choose follow some scientific pursuit in his hours of leisure. Happy, I say, is that man who elects to do so.

But I find that my address is passing into a kind of preaching. Still, as this is the last time I shall speak to you from this chair, I was anxious to gain the ear of our young friends in the hope of wooing them to our ranks as naturalists. I am persuaded that the young folk of this neighbourhood could hardly be better placed for the purposes of Natural Science study. Surrounded by beautiful scenery, which of itself is enough to enkindle a love of Nature, they have enormous advantages over the dwellers in less picturesque districts. But your county is not only beautiful—it is full of instruction to the geologist, the botanist, and the zoologist. A whole world of interest is at your very doors; and when I think of all your many advantages in this respect, I wonder why Perth has not produced a larger number of naturalists. The dawn of better things, however, has come. This Institution, of which your Society is the fortunate possessor, is one which many larger towns might well envy, and it will doubtless greatly stimulate the study of Natural Science in your midst. It has been a very sincere pleasure to me to have been with you, and to have shared all the hopes and fears of the past few years. When our late esteemed President first broached the scheme which has since been so happily realised, it seemed to many to be rather utopian. "It was too much to expect in Perth," I was told again and again. But Perth is not quite the "sleepy hollow" it may at one time have been. The intellectual stir which has wakened up the world at large has reached even the banks of the Tay. And I am much mistaken if in the future this Institution does not become a very considerable factor in the intellectual advancement of this part of Scotland. I look upon it as the nucleus of what will some day become a most important school of science.

And now, in conclusion, I have only to thank you for your kindness in having so patiently listened to me. I am sorry that the time has come when I must cease to be an active member of this Society. From one and all I have received invariable courtesy and kindness, and have formed friendships which are not likely to be interrupted on this side of time. Your beautiful county I have come to know as well as many of yourselves know it, and to love with a fervour hardly less intense than that of a real native. But as Edinburgh, to which I go, is hardly a hundred miles from Perth, I cherish the hope of returning now and again to review my acquaintance with the Fair City, and take part in your proceedings here. Meanwhile, I must say farewell, and in doing so I fervently wish you all God speed.

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### April 13th, 1882.

Mr Magnus Jackson, Vice-President, in the Chair.

#### NEW MEMBERS.

The following were nominated for election as members of the Society:—Dr Urquhart, Murray House; Councillor Whittet, Councillor Love, and Mrs Baxter, St Leonard Bank.

The following new members were unanimously elected: —Captain Smythe, Mr Brooke, Miss Stewart, Mr Keillor, Mr Hunter, Mr Donald, Mr John Campbell, and Mr Leslie.

#### DONATIONS.

The following donations were intimated:—From Mr Logie, Rannoch—two golden plovers; Thomas Marshall, Stanley—one woodcock; Sir W. Baynes, Bart., Merfield

—two stoats; J. Martin White, Dundee—one yellow hammer, one chaffinch, one wren, aud one longtailed tit; Mr M'Lean, Murie House, Errol—one hooded crow; Mr Fraser, Innergeldie—one peregrine falcon; James Keay, Murthly—two pairs woodcock eggs, and one bat; Mr Hollingsworth, Errol—one kestrel bawk; P. D. Malloch, High Street—one common gull, one common bunting, one ringed plover, one dipper, one meadow pipit, one yellow hammer, and two pied wagtails; Mr Hunter, Balhary—one sparrow hawk; Mr Crerar, Faskally—one stoat; James Keay, Murthly—one redpole, and one golden-crested wren; Gr. M'Gregor, Moncreiffe—one tawny owl; P. D. Malloch, High Street—one common bunting, and one lark; Mr Logie, Rannoch—one raven; P. D. Malloch, High Street—one dipper, one song thrush, two sky-larks, two hedge-sparrows, two cole-tits, one grey wagtail, one chaffinch, and one longtailed tit; Mr M'Intosh, Aberuchill—one jay, and one starling; Mr Keay, Murthly—dabchick, one redshank, one hedge-sparrow, one longtailed tit, and one golden-crested wren; Mr Haggart, Murthly—one jay, and one grey shrike; Mr Keay, Murthly—one grey wagtail; John M'Niven, Edinchip—two lesser black-backed gulls; Messrs J. & H. Coates—a collection of the land and fresh water shells of Perthshire; Mr Patrick Geddes, F.R.S.E.—pamphlets; Torry Botanical Club, New York (in exchange), *The Torry Botanical Bulletin.*

Dr BUCHANAN WHITE communicated the following notes:—

1. *Pyrola rotundifolia.* This has been loug recorded as a Perthshire plant, but no locality mentioned. Having recently had an opportunity of consulting the late Mr Watson's herbarium (which is now at the Royal Herbarium, Kew), I find that the locality of his Perthshire specimens is Dunkeld, when the plant was found in 1840. It is very desirable that the exact station should be rediscovered; and the object of this note is to impress on any one who may botanize in that neighbourhood this summer to keep a look-out for the plant.

2. At the February meeting I communicated some notes on the flowering of plants in my rock garden. The following table gives the dates of a few species that have come into flower since that time. From these it would appear that plants are about 37 days in advance of what they were last year, though it is probable that the ungenial weather we have recently experienced will tend to reduce the disparity between 1882 and 1881. The horse chestnut on the Bowerswell Road, whose precocity in coming into leaf I mentioned in my notes of February, came into leaf about March 15, which is about 43 days sooner than it did last year, 21 days sooner than in 1880, and no less than 46 days earlier than 1879. I observed in one of the newspapers lately that swallows had been seen some time ago at (I think) Butterstone. This is probably an error of observation, the birds iu question being probably sand-martins, and not the true swallow. All members of the *Hirundidæ* (the swallow family) are called swallows by careless observers, and hence these erroneous and misleading records of early appearances; while the fact is that the martins, and especially the sand-martins, are always earlier in arriving than the true swallow, and not unfrequently appear in March. Apart from other differeuces, the longer and pointed forked tail of the swallow serves to distinguish it at a glance from the martins, which have squarer tails:—

| | 1877 | 1878 | 1879 | 1880 | 1881 | 1882 |
|---|---|---|---|---|---|---|
| Saxifraga oppositifolia alba, | Mar. 2 | Feb. 20 | Mar. 10 | Feb. 21 | Mar. 16 | Feb. 18 |
| Do. do. vulgaris, | Mar. 22 | | Mar. 20 | Feb. 22 | Mar. 20 | Feb. 12 |
| Erysimum pulchellum, | | | | | Mar. 22 | Feb. 18 |
| Crocus (common yellow), | | | | Mar. 9 | Mar. 15 | Feb, 3 |
| Draba aizoides, | | | Apr. 10 | Mar. 14 | Apr. 14 | Feb. 24 |
| Do. aizoon, | | | | | Apr. 4 | Feb. 27 |
| Saxifraga oppositifolia major, | Mar. 18 | | Mar. 12 | Mar. 2 | April | Feb. 24 |
| Hacquetia epipactis, | | | Mar. 20 | Feb. 18 | Mar. 28 | Feb. 6 |
| Luzula campestris, | | | May 3 | Mar. 5 | Apr. 6 | Mar. 15 |
| Primula denticulata, | | Feb. 23 | Mar. 20 | Feb. 22 | April | Feb. 16 |
| Do. marginata, | | | | | Apr. 10 | Mar. 18 |
| Viola hirta, | | | Apr. 22 | Mar. 29 | Apr. 14 | Mar. 27 |
| Corydalis cava, | | | Apr. 10 | Mar. 5 | Apr. 15 | Mar. 15 |
| Do. bulbosa, | | | Apr. 24 | Apr. 5 | Apr. 15 | Mar, 15 |
| Draba rupestris, | May 6 | April | | | Apr. 14 | Mar. 27 |
| Ranunculus ficaria, | | | Apr. 15 | Mar. 4 | Apr. 16 | Mar. 10 |
| Salix caprca, | | | Apr. 18 | Mar. 20 | Apr. 14 | Mar. 10 |
| Schivereckia podalica, | | | Apr. 10 | Mar. 6 | Apr. 12 | Mar. 15 |
| Doronicum caucasicum, | | | | Mar. 30 | Apr. 21 | Feb. 23 |
| Anemone nemorosa, | | | May 4 | Apr. 6 | Apr. 22 | Mar. 28 |
| Carex ornithopoda, | | | May 11 | Apr. 8 | Apr. 20 | Mar. 28 |
| Oxalis acetosella, | May 6 | Apr. 24 | May 3 | Apr. 7 | Apr. 24 | Mar. 28 |
| Cardamine trifolia, | May 1 | Mar. | May 7 | Mar. 14 | Apr. 21 | Mar. 15 |
| Viola sylvatica alba, | | | May 10 | Apr. 9 | Apr. 24 | Mar. 26 |
| Myosotis dissitiflora, | | Feb. 23 | Apr. 22 | Mar. 1 | April | Feb. 16 |
| Arabis lucida. | | | Apr. 25 | Mar. 14 | Apr. 26 | Mar. 15 |
| Corydalis lutea, | | | | Apr. 16 | May 1 | Mar. 21 |
| Do. ochroleuca, | | | | Apr. 7 | Apr. 28 | Mar. 12 |
| Horse Chestnut on Bowerswell Road, | | | May 1 | Apr. 5 | Apr. 27 | Mar. 15 |
| Dicentra formosa, | | | | Apr. 7 | Apr, 25 | Mar. 15 |
| Arenaria balearica, | May 4 | Apr. 24 | May 16 | Apr. 24 | May 4 | Mar. 28 |
| Anemone coronaria, | | May 15 | May 8 | Apr. 20 | May 7 | Feb. 22 |
| Geranium robertianum album, | May 23 | Apr. 30 | May 22 | Apr. 9 | May 14 | Mar. 20 |
| Viola biflora, | | | | Apr. 29 | May 12 | Apr. 1 |
| Saxifraga Stansfieldi, | May 9 | | May 16 | Apr. 23 | May 9 | Mar. 28 |

3. *Viola sylvatica, Viola canina,* &c. The common wood and dog violets are abundant enough everywhere, but those who have not paid attention to them would be astonished at the amount of variation presented by a series of specimens collected in different localities, and brought together for comparison. It is very desirable to endeavour to ascertain the extent of this variation in Perthshire, and I would therefore beg members to collect specimens from different localities in their districts, and preserve them for the Society's herbarium. The plauts should be taken up by the roots, and a note of the locality kept with the specimen.

The above note may be applied to other plants than the dog violets. Members should keep in mind that it requires no botanical skill to collect and preserve common plants, and that any Perthshire specimens will always be useful and valuable for our herbarium.

The following paper was read:—

'*Notes on the Mollusca of Perthshire.*" By Mr Henry Coates.

Twelve years ago a small volume was published containing the proceedings of our Society for the Session 1869-1870. In that volume will be found no less than five communications devoted to the mollusca of Perthshire, some recording the occurrence of certain species, others detailing the distribution of groups. During the years that have intervened since then I think I am correct in saying that the total number of papers that have been brought before us on this subject does not exceed the number above mentioned. This is to be regretted, as there is much interesting work to be done both in studying the structure and habits of these creatures, and in working out their distribution in our district.

Some may ask in surprise, what interest is to be found in the contemplation of snails and slugs, beyond the facts that some have s. ells and some have not, and that all have the unpleasant propensities of destroying our favourite plants, and of crawling across our path after every summer shower of rain? In reply I would ask you to remember that in our own county alone there are to be found some five dozen different species of these despised creatures, each having its own peculiarities of structure, its own habits and haunts. The only paraphernalia necessary for the study of the mollusca are a supply of pill-boxes and a good pocket-lens; and, for aquatic species, a drag net. The microscope and dissecting instruments are valuable adjuncts if we have time and inclination for a more thorough investigation.

The all-important question with the beginner is—Where are the objects of our search to be met with? To this the simplest reply is, in any spot which has been for long undisturbed by the hand of man. They are to be met with in every glen, either adhering to the damp rocks and stones, buried amongst the moss and loose debris, or crawling up the blades of the reeds and grasses. They are to be found in every disused quarry, in the stone heaps gathered off the fields long ago, and on the sunny banks of old pasture edging streams and rivers. Every pond and ditch which has stood for fifty years or more will yield a rich harvest of aquatic species, and even our swiftest rivers are the home of the hardy pearl mussel. But we must remember that not a tenth of these shy creatures will reveal themselves to the casual observer, and this for two reasons. In the first place, they generally lie concealed in crevices of the rocks, or beneath stones and moss, where the rays of the sun cannot penetrate to dry up the mucus in which their bodies are enveloped, and from these retreats they only crawl abroad after a shower of rain has moistened the ground. In the second place, our difficulty is not only to unearth them, but to see them when unearthed, for some are not more than the twentieth part of an inch in diameter, and the fortieth of an inch in height, and many are of the same dusky hue as the earth itself. Our search may be prosecuted nearly all the year round, but I have generally found autumn to be the best collecting season, as the ground is then warm and moist, and the mollusca besides are then in best condition. In the cold weather of spring and in the dryest days of summer they retire farther into their retreats, though it is interesting to note that even in the depth of winter a few have the hardihood to venture out of their hiding-places, and have been seen crawling on the snow itself.

Of the mollusca comprised in the following list, most have been taken by my brother and myself. Specimens of these, or more correctly of their shells, will be found in the collection which we have formed for the Museum of the Society, and the notes regarding them are the result of jottings made during our excursions to pond, stream, wood, and glen. In order, however, to make the catalogue more complete, reference is made to some other species which have already been recorded from the district, but with which we have not yet met. In all such cases the recorders' names are mentioned. The "slugs," or mollusca having an internal instead of an external shell, have been excluded from the list, as I have not yet been able sufficiently to work up their distribution. These, however, may appropriately form the subject of a separate paper, and I commend the study of them to members of the Society as a field in which much has yet to be done.

1. *Sphærium corneum.* The only representative of this genus yet found in the district occurs in tolerable abundance in most of our old ponds. It may be distinguished from its allies the Pisidia by the dark horn colour of the shell.

2. *Pisidium fontinale* seems to be about equally distributed throughout the ponds of the district with the other two species.

3. *P. pusillum*, and 4. *P. nitidum.* These minute

bivalves are difficult to distinguish from each other, especially as they are frequently coated with an algoid growth, or stained with iron and manganese. Their most reliable character is the contour of the shell; the first-named species being the most triangular, the second more oval, and the third nearly round. All are to be found in the mud of stagnant pools, some of which should be put in a canister to be examined at leisure. Any one may find them in abundance by examining the pools of Methven Bog in this way. The variety *pulchella* of *P. fontinale*, which well deserves its name, is not uncommon.

5. *Unio margaritifer*. As I described this most interesting species pretty fully last session, I need only say that it inhabits the Tay and nearly all its tributaries, as well as a number of the Highland lochs. The varieties *sinuata* and *Roissyi* both occur in the Tay.

6. *Anodonta cygnea* was first discovered in Perthshire by Mr W. Herd, who detected some specimens both of the type and of the variety *incrassata* in a pool of the River Earn in 1869. It has since been taken in a pond near Dupplin Castle by Mr F. Smith, and in Scone Pond by Dr Buchanan White, who, it will be remembered, recorded his find two years ago.

7. *Valvata piscinalis* has been found in rivers, lochs, and ponds in the lowland part of the country, where it is not uncommon.

8. *Planorbis nitidus*. I have not found this species myself, but have some specimens taken by Dr Buchanan White in ponds near Perth, where it was observed by him in 1870.

9. *P. nautileus* is recorded by Mr J. Dawson from Old Scone, and has been found by Dr Buchanan White at Moncreiffe.

10. *P. albus* is the most widely-distributed of the genus, particularly in the Highlands, where it inhabits ponds at considerable altitudes. It is easily distinguished by its dull white aspect, and by its strongly-marked striæ.

11. *P. vortex*. This beautiful little shell has only, I believe, been taken at Errol and near Dunning.

12. *P. contortus* is common throughout the district, and may be known by its closely-coiled whorls.

13. *Physa hypnorum* was detected as a Perthshire species by Mr J. M'Farlane, who discovered it at Errol in March, 1870.

14. *P. fontinale*, which is to be distinguished from the preceding species by its much shorter spire, is found in most ponds and slowly-running streams throughout the county. The shell varies much, both in size and thickness, and in the height of the spire.

15. *Limnæa peregra*. This is at once the commonest and the most variable of our freshwater shells. Few pools or sluggish streams are without specimens of it. Jeffreys describes fourteen varieties of this species, of which about half may be found in the county. The finest specimens I have taken were from some of the dead-waters or old channels of the River Earn.

16. *L. palustris* has a pretty wide range in the district, but is nowhere abundant. The shell is very handsome, and differs from that of the preceding species in its thick texture, prolonged spire, and dark olive or horn colour. I have found the variety *elongata* not uncommon, and have seen fine specimens of the variety *decollata* gathered by Dr Buchanan White at Dunkeld.

17. *L. truncatula* occurs in many localities. It appears to be partial to ponds at elevated situations, where, however, it seldom attains its full size. The shell differs from that of the preceding species in being much smaller, and having the sutures (or lines of junction between the whorls) deeper. Though an aquatic species, I was surprised to see some specimens of this little mollusc crawling on a dry bank in Quarrymill Den, at a considerable distance from the stream, but I have since found that it not unfrequently assumes an amphibious habit for a time, in order to deposit its spawn upon the banks.

18. *L. glabra* was added to the Scottish list by Dr Buchanan White, who discovered it in some small pools on the Muir of Durdie. How it was introduced into this lonely habitat is a problem not easily solved.

19. *Ancylus fluviatilis*. This limpet-like mollusc generally chooses running streams for its habitat, where, unlike other freshwater snails, it is in no danger of being swept away by the current, but sticks fast to the stones by means of its broad muscular foot. It is common throughout the district in suitable situations, but is frequently overlooked, as the shells are easily mistaken for little heaps of mud adhering to the stones.

20. *A. lacustris* occurs in some of the dead-waters of the River Earn near Dupplin, and at Moncreiffe, where it was first discovered by Dr Buchanan White. It is found adhering to the smooth stems of the iris and reeds, and is at once distinguished from the preceding species by its oblong shape. The variety *albida* occurs in the same place. This completes the list of aquatic species.

With regard to the land mollusca I may remark that if any member wishes to make acquaintance with them for himself, he has ample opportunity of doing so in this neighbourhood, for a few excursions to Kinnoull and Moncreiffe Hills will reveal a large majority of the species yet

known to be natives of Perthshire. I have only given descriptions of species where such might help beginners to distinguish between species closely resembling one another, and in such cases only some leading characteristics are given.

21. *Succinea putris,* although a true land snail, is almost amphibious in its habits, as it frequents the wet banks of lakes and streams, and is sometimes even found in the water. In Perthshire it occurs at several stations, but is not common.

22. *Vitrina pellucida* is at once distinguished by its fragile and globular shell, which is of a pale green shade, and, as its name implies, nearly transparent. It is abundant everywhere throughout the county, particularly in moist situations, and beneath moss and stones.

23. *Zonites cellarius.* The genus *Zonites*, which is distinguished from the typical genus *Helix* by the semi-transparent and glossy character of the shell, will probably present the greatest difficulty to the beginner, on account of the similarity between young specimens of the larger species, and full-grown specimens of the smaller; but the eye will soon be able to detect immature shells of any species. The present species is universally distributed throughout the district, and seems to prefer damp and shady situations. One distinguishing feature is the flatness of the upper surface of the shell.

24. *Z. alliarius,* if found alive, is not to be mistaken for any other species, on account of the strong odour of garlic which it emits, and by which, indeed, I have often tracked it to its hiding-place. The shell differs from that of the last species in being of a darker shade of horn, more glossy, and slightly more convex. It is not quite so common as the last, and seems partial to woods, where it hides amongst moss at the roots of trees.

25. *Z. nitidulus* is the commonest of the genus, and is found in a great variety of situations. It differs from all the others of the genus in the dull, waxen lustre and greater convexity of the shell, especially on the under side.

26. *Z. purus*, known by its pale horn colour, is widely distributed, the white variety, *margaritacea,* being rather more so than the type.

27. *Z. radiatulus* occurs in several localities, but is not common. It is found amongst stones in rather dry situations. The shell is of a rich brown colour, and beautifully sculptured with radiating striæ.

28. *Z. crystallinus.* This most beautiful little shell is partial to shade and moisture, and will generally be found in deep wooded glens, amongst the soft moss and decaying leaves and ferns. Some of the latter should be collected in a bag and taken home for examination. After having been spread out on a newspaper until they are perfectly dry, they should be sifted two or three times, each sifting being carefully examined. In this way a number of minute species will be found which could scarcely be detected by any other means.

29. *Z. fulvus* may be distinguished from all the other species of the genus by its raised spire. It is widely distributed, and found in a great variety of situations.

30. *Helix lamellata.* We have now reached the typical genus of land snails, which is distinguished from the preceding genus by the shell being generally more solid and less glossy. The present species is nowhere very common, and in Perthshire, has only, I think been taken in the neighbourhood of Birnam, where it was first detected by Dr Buchanan White.

31. *H. aculeata* is remarkable on account of the crown of spines with which the shell is ornamented. It is common throughout the district on stones and rocks.

32. *H. aspersa* is the largest of our Perthshire species. In England, and particularly in the south of England, this is the commonest and most widely distributed of the land molusca, but in Scotland its range is chiefly confined to the sea coast. During one of the earliest excursions of our Society, however, a colony was discovered on Kinnoull Hill, and since then it has been found at several other stations in the lowland part of the county.

33. *H. nemoralis*, which will be at once recognised by its brown spiral bands, is pretty widely distributed. It is probably the commonest species in gardens. I have taken the varieties *hortensis* and *hybrida* as well as the type, on Kinnoull Hill. The first of these, which is known by its white lip, is nearly as common as the type in the lowland districts, and I think more so in the Highland districts. The variety *minor* has been taken by Dr Buchanan White at Blair-Athole, and has also been found at Balgowan.

34. *Helix arbustorum* is the most finely-marked of the larger species, being of a rich brown colour, mottled with a darker shade of the same, and very glossy. It is pretty common in woods and on old walls, in moist situations. The variety *alpestris* is not uncommon.

35. *H. concinna*, and 36 *H. hispida*, are equally distributed, and are frequently found in company in dry situations, such as stone heaps and old quarries. I confess I am unable to distinguish the empty shells of the one species from those of the other, but the animals may be known by the lighter colour of the foot in *H. hispida*. The variety *subrufa* of the latter is not uncommon. I have frequently taken these and other species by sweep-

ing the long damp grass in woods and shady places with a butterfly net.

37. *H. fusca* seems to be chiefly confined to the Highland districts of the county, where it is found in shady glens. It has been taken in Glen Farg and Glen Tilt, and at Dunkeld and Pitlochry. The shell is extremely fragile and transparent, and may be mistaken for a very young specimen of *H. nemoralis*.

38. *H. rotundata* is the most abundant of the genus, and is distributed throughout the district. It is partial to dry situations, such as stone heaps and old walls, and is at once recognised by its strongly-marked striæ. I have taken the variety *pramidalis* in Quarry Mill Den, and the variety *alba* at Pitlochry. The latter variety has also been found by Dr Buchanan White on Kinnoull Hill.

39. *H. rupestris* is a rare shell in Scotland, and in Perthshire has only, I think, been found on Kinnoull and Moncreiffe Hills, where it is uot uncommon on the cliffs.

40. *H. pygmæa* is the smallest of our land mollusca, being not larger than the head of the smallest pin, and about the same shape. Being morever of an earth-brown colour, it will be understood that this species is not in danger of being exterminated by the ruthless collector! It is widely distributed, and a careful search amongst decaying leaves or loose stones in suitable situations will generally be rewarded by a few specimens.

41. *H. pulchella* is well named the "beautiful snail," for its tiny white shell is ornamented with a porcelain-like ring surrounding the mouth, and, in the variety *costata*, with radiating ridges, caused by folds of the epidermis. It is found on Moncreiffe and Kinnoull Hills, but is not common. All the specimens I have taken myself appear to belong to the variety *costata*.

42. *Bulimus obscurus*. This genus and the remaining genera are distinguished from the preceding ones by having the spire prolonged so as to give the shell a cylindrical form. The present species is common both in the Lowland and Highland districts, and is found in dry situations, such as stone heaps and grassy banks.

43. *Pupa umbilicata*. This little mollusc is generally found in company with the last, with which it has an equally wide range. Immature specimens of both of these shells are so unlike mature specimens as to be puzzling at first sight, but in such cases the texture of the shell is the best guide.

44. *Pupa marginata*. Dr Buchanan White informs me that he has taken this species on Kinnoull Hill. The shell is very similar to that of the preceding species, but the lip is rounder, and strengthened by an outer white rib.

45. *Vertigo substriata* is not uncommon amongst stones and long grass, but is probably often overlooked on account of its minute size.

46. *V. edentula* is found in similar situations to the last, but is more widely distributed. 46.* *V. antivertigo* has been taken by Dr Buchanan White in damp places at Quarry Mill.

47. *Balia perversa* is rather local, but not uncommon where it does occur. It is found on rocks and old walls on Moncreiffe and Kinnoull Hills, and has been taken by Dr Buchanau White at Dunkeld.

48. *Clausilia rugosa*, though much more abundant than the last, is also rather local. It is the commonest species on Kinnoull Hill, where it abouuds, not only on the cliffs, but frequently on the trunks of the trees. Rocks form its favourite habitat. The varieties *tumidula* and *Everetti* are not uncommon.

49. *C. laminata* is the rarest of our local mollusca, for one rock in the neighbourhood of Perth is the only station in which in has yet been taken in Scotland, and even there it is not abundant. It was discovered here by Dr Buchanan White, in whose name it is recorded in the appendix to Jeffrey's British Conchology.

50. *Cochlicopa lubrica* is widely distributed, both in the Lowlands and Highlands of the county. It is found amongst moss and stones aud in moist situations, and is recognised by its very glossy and gracefully-shaped shell, which is nearly transparent. The variety *lubricoides* is not uncommon, and I have taken the variety *viridula* on Kinnoull Hill.

51. *Carychium minimum*, though one of the least of our land shells, is probably the most beautiful. The shell is pearly-white, and exquisitely formed. It is widely distributed, and found in the same situations as the last.

The foregoing does not pretend to be a complete list of the mollusca which inhabit the ponds, woods, and glens of Perthshire; indeed, I have reason to suspect that it is far from complete. But it will have done its work if it serves in any measure as an inducement to some members to visit for themselves the haunts of these creatures, and to taste the charm of prying into Nature's most secluded nooks and corners.

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MAY 4th, 1882.

Colonel DRUMMOND HAY, President, in the Chair.

NEW MEMBERS.

The following were elected members of the Society:—

Mrs Baxter, St Leonard's Bank; Mr Joseph Munro, Queen Street, Craigie; Mr Robert Dow, Stewart's Free School; Dr Trotter; Dr Urquhart; Mr J. P. Whittet; and Mr T. Love.

DONATIONS.

The following donations were intimated:—Skull of a mole—by Mr James Stewart; fern rhizomes—by Mr Sutherland, Peel; a jay—by Mr Young, Freeland; a woodcock—by Mr Graham, Kildinny; a merlin hawk—by Mr Logan, Rannoch; a wheatear—by "M.R.S.," Rannoch; tawny owl, chaffinch, creeper, thrush's nest and eggs, a wren, and a hedge-sparrow—by Mr M'Lean, Murie House; and two hedgehogs—by Colonel Drummond Hay.

THE LATE MR DARWIN.

Dr BUCHANAN WHITE said the Society should not allow this opportunity to pass without putting on record its deep regret at the death of the foremost naturalist of the age, Mr Darwin. It was not necessary that he should enter into any eulogium of Mr Darwin, as he was well known all over the world; aud, therefore, he simply moved that the Society record in its minutes its unfeigned regret at his death, and its admiration of his work.

Mr JOHN YOUNG seconded, and the motion was unanimously agreed to.

The following paper was read:—

"*On the Animal Nature of Euglena viridis.*" By Professor Allen Harker.

If we collect from stagnant ponds, or even from our rain-tubs at this season of the year, specimens of the water, we shall, in all probability, find it tinged of a bluish green colour; and on an examination of this coloured water, we shall generally find that this greenness is due to the presence of a moving green-coloured organism, about the 500th of an inch in length, which is known as *Euglena viridis.* It is cylindrical in form, tapering to a point at the posterior extremity, and abruptly rounded at the anterior pole; near the latter is a minute notch, from which springs a long flexible hair-like organ, termed the *flagellum,* which is constantly kept in motion, and by its lashing propels the creature through the water with a rolling action around the longer axis of its body. The body seems to be partially made up of granular structures, and near the anterior extremity is a brilliant crimson or red spot, characteristic of many of the lower forms of both animal and plant life. Up to within a few years ago considerable doubt existed as to whether this organism was an animal or a plant. Von Stein had, indeed, always described it as a flagellate infusorium, but others had again considered it a plant. Huxley, in his *Anatomy of the Invertebrates,* while alluding to it as an infusorium, had said, "Euglena may turn out to be a plant," and until recently, it was given as an example of the motile condition of an alga in some of our public schools of botany. Four or five years ago, I took up the study of these organisms, and, after some time, became so convinced of their animal nature, that I carried out a long series of observations and experiments on them, which cannot yet be said to be completed. Some of those results are now offered to your notice, together with contemporaneous observations of Kent and Stein, which have settled indubitably the animal character of the *Euglenidæ.*

In the first place, the behaviour of the creature in its active condition, while exhibiting some features suggestive of the motile condition of an alga, at the same time exhibits striking differences. Notably in its behaviour while swimming through the water, and in coming in contact with obstacles to its progress, Euglena has the power of contracting the outer layer of its body, and creeping round or under and over an object in its path, while any motile plant, such as a diatom or a zoogonidia, progresses only in a straight line, and, meeting with an obstacle, invariably backs away, and takes up the same or another direction in a straight line. This flexibility of the body is quite an animal character. This property of Euglena gives rise, too, to its habit of assuming a variety of forms, from its usual elongate, spindle shape, to sometimes that of a perfect spherical one. It very frequently becomes repent, and crawls over the surface of the field; some species, indeed, never assuming any other mode of progression than this repent form. Any one watching this rapid change of form in Euglena, varying at almost every moment, cannot fail to be reminded of the behaviour of undoubted infusoria, such as the ciliate *Paramecium* or its flagellate congeners. The long flagellum, again, is unlike any structure possessed by an alga in any stage, the cilia of motile spores in Protococcus, &c., being temporary in character.

In keeping Euglena in bottles, a time soon came when a permanent change took place, the creature assuming a spherical form (the flagellum disappearing) aud falling to the bottom. It might at this stage surround itself with a coat of a yellow substance, whose composition is not known, and in this encysted condition reproduce by two distinct methods. The first is by simple fission, and this seems to be very common. During these observations

it occurred frequently that the two organisms resulting from this simple fission exhibited the characteristic euglenoid movements some considerable period before they were released from their cyst, and furthermore exhibited the well-known eye spot at this early stage. The rupture of the enclosing walls released two perfect Euglenæ.

The other method is one less frequently observed, but of very great interest, as being of a like nature to what has been described in certain very minute Infusoria of the flagellate group. After a prolonged period of encystment, the contents appear to be segregated into a great number of minute, irregular-shaped bodies, which, on the rupture of the cell wall, escape and creep about actively with amœboid movements, each of these becoming in time an adult Euglena.

There is still another mode of reproduction, by repeated division, which takes place during the winter months, and principally provides for the coming season's stock.

At this stage of my researches I was so fortunate as to discover a pond which supplied me with three or four other species of the genus Euglena, most of them of larger size than *viridis*, and consequently more easy to study. These species were *E. spirifer*, *E. deses*, and *E. rostrata*. [Prof. Harker described the special features of these species by the aid of coloured diagrams.]

In the largest of these I succeeded in finding a contractile vesicle exhibiting systolic and diastolic action—an organ characteristic of Infusoria.

On applying various chemical tests to these Euglenæ, I have been utterly unable to find the presence of any starch: the reactions are precisely similar to those given by all animal organisms, iodine turning them brown, and this notwithstanding the fact that the green colouring matter of the *Euglenidæ* is chlorophyll. With Algæ, the reaction given by iodine invariably shows the presence of starch. I have applied this test in many hundreds of cases: first of all, with every species of green-coloured Algæ that I could procure; in the second place, with not only the *Euglenidæ*, but all such green-coloured infusoria as *Phacus* and *Trachelomonas*, with a like result.

About this time, almost simultaneously, Stein, in Austria, and Kent, in England, succeeded with an experiment which may be said to set at rest the question of the position of Euglena. They supplied it with particles of carmine, just as in the laboratory we are in the habit of feeding some of the larger infusoria, and succeeded, under very high powers of the microscope, in actually watching individual specimens ingest solid particles of carmine. This was performed through a very minute orifice, situated at the bottom of the notch already described, from the vicinity of which springs the *flagellum*, and which, therefore, is a true mouth. In the larger species, *E. deses* and *E. spirifer*, I have succeeded in watching a similar act, and noticed that the flagellum played a prominent part in aiding the operation.

I have by various chemical processes, which I need not at present detail, separated from Euglena both chlorophyll and xanthophyll. This very interesting question of the colouring matter undoubtedly suggests a vegetable affinity, but we must bear in mind that other animals are coloured green by chlorophyll, too.

To sum up; both by its mode of progression and reproduction, the flexibility of its cuticular layer, the chemical reactions of its substance, its modes of taking food, we are led to the conclusion that Euglena is properly classed by Stein as a Flagellate Infusorium.

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## SUMMER SESSION, 1882.

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The following Excursions were made:—

JUNE 3rd.

1, *Logierait*.

The ground selected for exploration was the banks of the River Tay between Logierait and Dunkeld, and the party was under the leadership of Dr Buchanan White. As may easily be imagined by anyone familiar with any part of the banks of our noble river, these present to the naturalist a rich field for observation in almost every department of natural history. Strange to say, however, these banks have not been explored so exhaustively as would have been expected, and consequently it has been left to the Society to carry out a thorough exploration of this comparatively untrodden field. But from the great extent of the ground, and as a rapid traverse of it is not sufficient for the purpose, it will still be some time before even a superficial examination is made. Looking at the river banks from a botanical point of view, a walk from, say, Invergowrie to Dunkeld, would give a

botanist otherwise quite ignorant of the botanical or topographical features of Perthshire much information on these subjects. In the lower part of the river he would he able to see at once that he was not far from the sea. As he approached Perth the various plants by which he had recognised his maritime position would be found gradually to disappear, while others—not being natives, but the outcasts of gardens and cultivated grouud—would indicate to him that the country hordering on the river was rich in gardens. A little above Perth, his hotanical knowledge would suggest to him that the river came from a district containing mountains of a considerahle height, as he would note here and there specimens of alpine plants that had been brought down by the stream and taken root in favourahle situations, while at the same time he would find indications that further up the river were more gardens and cultivated ground. Nor would an ohservant zoologist or geologist tread the river hanks in vain. To them also these overflow with facts full of instruction to those trained to read them aright.

The river at Logierait may he taken as a fair sample of what the Tay is in its upper reaches. Without particularizing localities, the river banks in this part of the course of the Tay may be described as presenting in succession four chief kinds of ground, varying somewhat in their local characteristics. It must be remembered that we are dealing only with the banks proper, *i.e.*, the ground between the fields and the water. In the first place, we find wide stretches of shingle, more or less overflowed hy the river when iu flood, and then sometimes forming islands. The lower and newer parts of these consist of water-worn stones only, hut in the higher and older portions sand and humus is mingled with the stones, and a scanty vegetation begins to appear. And this vegetation is full of suggestive instruction to the thinking botanist, for here he may see not only how one class of plants prepares the ground for another, which eventually supplants the first, to he iu turn supplanted; but he may form an idea of the manner in which the whole country was peopled with plants at the close of the last glacial epoch. In the second place, we find wide flat grassy haughs, formed prohahly hy the accumulation of soil on the top of the shingles, and more or less overgrown with vegetation of a more hushy or arhoreal nature. Thirdly, steep banks hordered hy the fields on one side and hy a rapid current on the other; and, fourthly, steeper and higher banks, sometimes breaking into rocks, and generally densely wooded.

This, then, was the nature of the ground traversed and that it was sufficiently rich in vegetation may be learnt from the fact that—even at this comparatively early season—nearly two hundred kinds of flowering plants and ferns were noted. Of these a few may be mentioned:—Globe Flower *(Trollius europæus)*; Columbine *(Aquilegia vulgaris)*, often an escape, but sometimes found native; Blue Lupin *(Lupinus perennis)*, a North American plant now beginning to hecome naturalised on the hanks of some of the rivers of Northern Scotland; Alpine Lady's Mantle *(Alchemilla alpina)*; *Potentilla procumbens*, *Saxifraga aizoides*, *Galium boreale*, *Veronica montana*, Cowslip *(Primula officinalis)* in countless numbers. Though so common here, yet the cowslip is a scarce plant in many parts of Scotland. *Oxyria reniformis*, *Polygonum viviparum*, Moonwort *(Botrychium lunaria)*, *Equisetum pratense*, &c. The rarest plant of the day was the whorled-leaved Solomon's Seal *(Polygonatum verticillatum)*, a plant found in only four or five places in Britain. In the locality where it was seen on Saturday it was discovered some years ago hy an Associate of the Society, Mr Charles M'Intosh, Inver.

Owing to the clouded sky, the zoologists of the party found less to do than the hotanists. The ornithologists were interested in watching the behaviour of the numerous oyster-catchers *(Hæmatopus ostralegus)* which inhabit this part of the Tay, and whose wild cries resounded far and near, mingled with those of the lapwing *(Vanellus cristatus)* and sandpiper *(Totanus hypoleucus)*, while now again from the woods came the melodious note of the cuckoo. Numerous sand-martins *(Cotile riparia)* flitted over the river, and an occasional grey wagtail (*Motacilla melanope*) flew across the stream.

The entomologists found occupation in heating the juniper bushes for the caterpillars of the somewhat rare *Thera juniperata*, while to their nets fell specimens of *Emmelesia albulata*, *Eupœcilia ciliella*, *Grapholitha ulicetana*, *Botys fuscalis*, and other insects.

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JULY 1st.

2. *To Doune and Blairdrummond Moss.*

On this occasion the Society went further afield than usual, and, leaving the basin of the Tay, explored part of the hasin of the Forth, which, though in Perthshire, is yet in other respects beyond the district to which the main work of the Society is restricted. The place selected for examination was Blairdrummond Moss, so well known in connection with the "reclaiming" opera-

tions carried on so successfully many years ago. Proceeding to Doune Station, the party was met by the Rev. Biot Edmonston, minister of Blairdrummond, who had kindly consented to act as guide to his fellow-members. Crossing the Teith by the old bridge, from which a most picturesque view of the historically-famous Doune Castle was obtained, Watston Loch was reached and examined for aquatic plants and mollusca. Of the former, none but the usual species to be met with in similar places were detected, though the abundance of white water-lilies in full flower elicited much admiration. On the other hand, mollusca were conspicuous by their absence. In the neighbourhood of the loch several plants were gathered, including *Veronica scutellata*, *Carex disticha*, *C. fulva*, *Habenaria chlorantha* (the butterfly orchis, with white and odorous flowers), &c.

The party then drove to Blairdrummond Moss, the special object of search on which was a species of heath, the *Andromeda polifolia*, which here attains its northern limit in Britain. That the "reclaiming" operations alluded to above had been rewarded with great success was apparent in the rich fields of beans, potatoes, and corn which cover a great part of the ground marked in the Ordnance Survey map as "Blairdrummond Moss." A little part still, however, remains, and to it the party took their way in search of the much-wished-for *Andromeda*. At first it seemed as if the search was to be in vain, for the reclaiming operations are still being carried on, and the physical characteristics of what remains of the moss are being quickly altered. At last, and by diligent searching in appropriate places, a tiny bit of the *Andromeda* was detected, and hailed with rapturous shouts, which quickly brought the other botanists to the spot. Subsequently, more of it was found, but it is much to be feared that sooner or later the *Andromeda* is doomed to become extinct as a Perthshire plant.

Amongst other plants noticed on the moss were *Nasturtium palustre*, *Potamogeton pusillus*, *Myrica gale*, &c.

Some interesting insects were also observed, the chief being the butterfly *Chortobius Davus*, the form being that found in mosses in the North of England and South of Scotland, and different from the Highland form, which is commoner in Perthshire.

Leaving the moss the party returned to Doune by way of Blairdrummond House, in the park surrounding which many magnificent trees were seen and duly admired. Under a noble oak near the house, some magnificent specimens of a rather local plant, *Ornithopus perpusillus*, were gathered, and here the whole party were photographed by one of the members,—two of whom had taken an opportunity during the day of obtaining several photographic reminiscences of the excursion. During the day about 160 species of flowering plants were noted.

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August 3rd.

3. *To Comrie and Glenartney.*

Starting from Crieff, the party drove by Comrie to Glenartney, up which they proceeded several miles, and then conducted the rest of their investigations on foot, gradually working down the glen till Comrie was again reached, whence they returned to Crieff in time for the last train. In Comrie some of the botanists were a little puzzled by the name of a house—"Hollandbush,"—which, after discussion, they concluded to be a local corruption of the Saxon word, "hollen," or "holyn," the old name of the holly. On reference to Jamieson's Dictionary, we see, however, that the form "holland," "holyn," was known to him. It is, however, after all, probably only a corruption of "hollen," and it is easy to imagine how such an alteration arose. A somewhat similar case is the corruption of "lilac" into "lily-aik" or "lily-oak."

During the excursion the geology of the district was demonstrated by Professor James Geikie, while the departments of zoology and botany were under the care of Dr Buchanan White. Dr Alexander Thom, jr., made preliminary arrangements for the excursion, but was, unfortunately, debarred by his professional engagements from accompanying his brother-members.

While passing Ochtertyre, Dr Geikie pointed out the distribution of the drift deposits. Between the Turret Burn and the lower end of the broad carse that stretches west to Comrie, the Old Red Sandstone conglomerate is buried under great accumulations of coarse shingle, gravel, and sand. These accumulations form the hillocks, banks, knolls, and hummocks lying between the high-road and Ochtertyre. Many large erratics occur in and upon them. They are morainic and fluvio-glacial deposits, having been brought together by two large glaciers—one of which (formed by the union of local glaciers descending from Glen Turret, and the valleys of the Barvick, the Keltie, and the Shoggie) flowed south and dilated into the hollow below Ochtertyre, while the other crept down from Lochearnhead, filling up the great loch, creeping down to

Comrie, and thence extending east as far as the Ochtertyre hollow. The great gravel-masses of the latter locality consist of the moraines of these two glaciers, and of the washed debris distributed by the torrents escaping from the melting ice. The perched blocks brought down on the top of the Loch Earn glacier are dotted along the hill-slopes overlooking the wide carse. After the ice had melted away, that wide carse-land was the site of a large lake, which covered all the low ground as far west as Comrie. This lake, however, was eventually silted up and drained: the silting being due principally to the action of the River Lednock and the Water of Ruchill. The Earn itself also contributed its quota of gravel, sand, and loam, but most of its sediment was required to fill up the hollows in its own valley that formerly existed between Comrie and St Fillans. The draining of the ancient lake appears to have been completed by the deepening of the outlet of the Earn near Strowan House.

In Glenartney the party had excellent opportunities of studying the Old Red Sandstone rocks which are seen standing on end. The high angle assumed by them is doubtless due to the great dislocation which hereabouts brings them down against the slate-rocks of the Aberuchill Hills. This large *fault*, as it is termed, has been followed in a north-east direction from the shores of Loch Lomond to the sea-coast at Stonehaven. It does not, however, always form the boundary line between the Silurian strata of the Highlands and the Old Red Sandstone. It crosses Glenartney, and enters the latter formation, through which it passes to north-east. The Knock of Crieff and Milquhanzie Hill, in the Crieff district, both of which are formed of conglomerate, lie on the north-west side of the fault. In Glenartney, marks of the old glacial period were observed everywhere. Thick accumulations of boulder-clay, with striated stones, cumbered the slopes of the valley, and now and again rock-striations,—the work of the great body of ice which formerly flowed down Glenartney were detected. The striæ pointed north-east or *down* the valley. The finely smoothed and rounded outline of many of the mountains within view also attracted attention, — the slopes of Crappoch Hill above Comrie being considered a fine example of glacial abrasion.

The earthquake phenomena of Comrie are probably connected in some way with the great N.E. and S.W. dislocation which traverses the country, and which doubtless indicates a line of weakness, along which rock-fissuring may be taking place at a considerable depth from the surface,—the motion and sound being propagated through the superincumbent rock-masses to the surface.

In the department of zoology nothing of interest presented itself. Vertebrate animals were few in number, and all the insects seen were species of universal distribution. Amongst flowering plants, however, more than one species of considerable interest was observed. Amongst those may be noticed:—The Dane-wort or dwarf elder (*Sambucus ebulus*), a plant much resembling the common elder or bour-tree, but whose stems, instead of being woody, are herbaceous, and die down every year. Its name of Dane-wort is said to be derived from its having been used to poison wine sent as a present to certain Danish invaders, but whether the plant derived its name from this, or whether the story was invented to fit the name, we know not. Another interesting plant was a form of the common knapweed (*Centaurea nigra*), in which the flower-heads were two or three times larger than usual, the individual florets being larger and more spreading. This form, which is what is termed radiant, is not uncommon on the seacoast, but very rarely found inland. The great prize of the day was, however, the discovery of *Agrimonia odorata*, a species closely allied to the common agrimony, but only once previously recorded as a Perthshire plant. On that occasion it was found at St Fillans, and some doubt was expressed as to whether it was indigenous there. Another rare plant was the Wall Lettuce (*Lactuca muralis*), which has not before been recorded for Perthshire. Though native in England, it seems only to be naturalised (and that rarely) in Scotland, and, though probably not wild in this locality, yet its occurrence is very interesting. It is a graceful plant, with a much-branched but slender panicle of small yellow flowers, more or less tinged with red. Amongst other but more common plants found during the day, the following, out of upwards of 200 species observed, may be enumerated:—*Viola lutea*, an entirely purple-flowered form; the Musk-mallow (*Malva moschata*); *Trifolium medium;* the Orpine (*Sedum telephium*); *Sedum anglicum; Sedum villosum; Galium boreale; G. uliginosum; Campanula latifolia; Myosotis repens; Rumex aquaticus; Polygonum viviparum*, &c., &c.

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SEPTEMBER 2nd.

4. *To the Lochs near Blairgowrie.*

On September 2nd, the fourth and final excursion for the season took place. The weather in the morning was very wet, but notwithstanding there was a good attend-

ance, members from various parts of Perthshire and Forfarshire making up an enthusiastic party. (As an example of what the enthusiasm of a naturalist may lead him to do, it may be mentioned that one member walked twelve miles through heavy rain to join the excursion, and, after working all day, walked again twelve miles home!)

The special object of this excursion was the investigation of some of the lochs that lie between Blairgowrie and Dunkeld. Many of the Perthshire lochs, especially the Highland ones, such as Lochs Tay, Rannoch, &c., lie in rock basins, and are the result of "ice-action." That is to say, they have been ploughed out of the living rocks by the great glaciers that long ago filled the valleys in which they are situated. The Blairgowrie lochs are not, however, of this nature, as they do not occupy rock basins, but are merely pools in the immense mass of rock-debris or gravel that has resulted from the great ice-sheet that once covered the hills. But if not altogether so interesting to the geologist, they teem with interest to the botanist. The one most botanically celebrated is Loch Cluny, on whose shores, about one hundred years ago, dwelt the Rev. Mr M'Ritchie, minister of the parish, and a good botanist, as may be learnt from the interesting account of the local botany that he has left in the old "Statistical Account." Since then the loch has been visited by several distinguished botanists, but it was not till six or seven years ago that it acquired its great celebrity. This came about by the discovery in it by two local botanists—Mr Abram Sturrock, of Rattray, and the late Mr Robb—of a beautiful aquatic plant, *Naias flexilis*, which had before then been only known, as regards the British Isles, to inhabit one lake in Connemara, in Ireland. Since that time Mr Sturrock has discovered *Naias* in several other lochs in the district, and has besides made many notable discoveries amongst the aquatic plants of the district. Under these circumstances, the excursionists were very fortunate in having Mr Sturrock as their conductor, and with his guidance the day's doings were most successful.

On arriving at Blairgowrie, the party drove to Loch Cluny, making one or two halts on the road to look at some interesting plants. Among these may be mentioned *Reseda lutea*, *Carduus nutans* (a very handsome thistle, with large drooping heads), and *Geranium columbinum*—three plants by no means common in Perthshire.

At Loch Cluny a halt was made to gather *Potamogeton borealis*, one of Mr Sturrock's recent discoveries. The Potamogetons are aquatic plants, with usually submerged leaves, though occasionally with floating ones also. Their flowers are inconspicuous and of no particular beauty, being small and green, but the foliage is often beautiful both in form and colour, the latter ranging through various shades of green and brown.

At Loch Cluny, *P. Zizii*, and a curious form of *P. pusillus*, were also obtained. The party then drove to Loch Marlee, where a boat was in readiness, and here some hours were spent in collecting various plants. Amongst these may be noticed *P. Perthensis*, another recent discovery of Mr Sturrock's, who has given this name to a plant which seems to have been found nowhere else, and has not yet been described. In addition to it, *P. obtusifolius*, *P. crispus*, *P. perfoliatus*, *P. lucens*, and its variety *acuminatus*, *P. natans*, *P. heterophyllus* and *P. rufescens*, as well as *Naias flexilis*, *Elatine hexandra*, *Subularia aquatica*, &c., were found.

Leaving Loch Marlee, the Lunan Burn was descended, and several other Potamogetons, including *P. prælongus* and *P. nitens*, added to the list. Before reaching Fingask Loch, the rather local *Ornithopus perpusillus* and the commoner *Hypericum humifusum* were gathered. At Fingask Loch the party again embarked, and went in search of a very curious plant,—*Ranunculus confervoides*,—which, unlike any other *Ranunculus*, flowers and fruits far under the surface of the water. Here also *Naias* was again found, as well as *Myriophyllum spicatum*, *M. alterniflorum*, &c. Passing on to the neighbouring White Loch, another new *Potamogeton*—*P. pseudonitens*—was added to the list, as well as magnificent specimens of the beautiful but evil-smelling *Chara hispida*.

In addition to the plants mentioned a number of microscopic plants were collected, and kept for examination at a future time.

Though, on the whole, the day was devoted to botanical investigation, the zoology of the lochs was not altogether ignored, a number of fresh-water mollusks being collected. Amongst these were the following species:—*Limnæa limosa*, *Physa fontinalis*, *Planorbis albus*, *P. contortus*, *Valvata piscinalis*, *Cyclas cornea*, and one or two species of *Pisidium*. Some insects were also observed, such as *Nepa cinerea* (the water scorpion), which is rare in Perthshire; several species of *Corixa*, &c. Mention may also be made of the bright green *Spongilla lacustris*, one of the few British species of fresh-water sponges.

# Perthshire Society of Natural Science.

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1882.

In publishing a List of Members of the Society, the Council wishes to call attention to some of the advantages belonging to Membership. Amongst these may be enumerated :—

1. The use of the Reading-Room and Library. These are open to Members every day; and the Library—a Catalogue of which has just been issued—contains the largest collection of Works in all departments of Natural Science, in the county. Important new works are added to it from time to time. In the Reading-Room many of the current scientific periodicals are to be found.

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PERTHSHIRE NATURAL HISTORY MUSEUM,
TAY STREET, PERTH, *20th November, 1882.*

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170. PARKER, Chas. S., M.P. Fairlie, Largs.
PATERSON, W. A. Croft House.
PEDDIE, D. Elderslie Cottage, Dunkeld Road.
PINKERTON, J. C. 25 George Street.
PITCAITHLY, George. Elcho Cottage.
175. PITCAITHLY, Miss. do.
PULLAR, Edmund. Keirfield, Bridge of Allan.
PULLAR, Howard. Balhousie Works.

Pullar, James F. Rosebank.
Pullar, Mrs Robert. Tayside.
180. Pullar, Robert, F.R.S.E. Tayside.
Pullar, Rufus D. Tayside.

Riach, Miss. Mansfield Place.
Richardson, Thomas. 15 Barossa Place.
Robertson, C. S. Balhousie Street.
185. Robertson, Charles. 92 High Street.
Robertson, Dr. Robert. Errol.
Robertson, John. Dunkeld.
Robertson, Miss. Springbank.
Robertson, Robert. Blairgowrie.
190. Robertson, Robert. Mansfield Place.
Robertson, Robert Hay. 22 High Street.
Robertson, William. 94 High Street.
Rowden, A. L. Inchbank House, Bridgend.
Roy, Mrs. Springbank.

195. Scott, A. T. Clydesdale Bank.
Scott, John. General Prison.
Scrigmeour, David. Methven.
Shields, John. Balhousie Castle.
Sime, James. 225 High Street.
200. Simpson, Dr. King Street.
Skeete, Horace. Bailbrook Lodge.
Skeete, Mrs. Horace. do.
Smart, David. Kinnoull, Perth.
Smith, R. B. Moncreiffe House, Craigie.
205. Smythe, Captain David M. Methven Castle, Methven.
Soutar, W. S. Blairgowrie.
Stalker, John. Logiealmond.
Stewart, James. 19 Princes Street.
* Stewart, John. do.
210. Stewart, Miss. Craigard, Kinnoull.
Stirling, David, M.D. 4 Athole Place.
Sturrock, Abram. Schoolhouse, New Rattray, Blairgowrie.
Swan, Miss. Bridgend.

Tait, Rev. Walter. Manse, St. Madoes, Perth.
215. Thom, Dr. Alexander, jun. Crieff.
Thomas, John. Barossa Place.
Thomas, John. Maxwelton, Kinnoull.
* Thomson, Hugh. Tay Street.
Thomson, W. B. 14 Marshall Place.
220. Trotter, Dr. Tay Street.
Turnbull, Mrs. Athole Crescent.

Urquhart, Dr. Murray House.

Watters, John. 17 Scott Street.
Wells, George. 9 Queen Street, Craigie.
225. Westwood, Alex. Princes Street.
* White, F. Buchanan, M.D., F.L.S. Annat Lodge.
White, F. I., M.D., M.R.C.P. Athole Place.
White, J. Martin. Balruddery, Dundee.
Whittet, C. S. 22 Mill Street.
230. Whittet, J. P. 5 Charlotte Place.
Whitton, Peter. Methven Castle Gardens.
Williamson, Robert. 170 High Street.
Wilson, Robert. 38 St. John Street.
Winter, John. 35 George Street.
235. † Wood, C. L. Freeland, Bridge of Earn.
Wylie, George. 7 George Street.
Wylie, Thomas. 7 George Street.

Young, George. 24 Marshall Place.
Young, James. 3 Watergate.
240. Young, John, C.E. Tay Street.
Young, Rev. J. Arngask, Damhead.

## HONORARY MEMBER.

Geikie, James, LL.D., F.R.S., Professor of Geology, University of Edinburgh.

## ASSOCIATES.

CATTENACH, William. Bankfoot.
* HERD, William. Scoonieburn.
M'INTOSH, C. Inver, Dunkeld.
SIM, John. 9 Commercial Street, Bridgend.

## CORRESPONDING MEMBERS.

FERGUSSON, Rev. J., M.A. Fern, Brechin.
GEDDES, Patrick, F.R.S.E., Assistant to Professor of Botany. Edinburgh.
* HARKER, Allen, Professor of Natural History. Royal Agricultural College, Cirencester.
ROY, J. 3 Loanhead Place, Aberdeen.
SADLER, John. Royal Botanic Gardens, Edinburgh.
SMITH, Dr. Angus, F.R.S. Manchester.
TRAIL, J. W. H., M.A., M.D., F.L.S., Professor of Botany. University of Aberdeen.

# PROCEEDINGS

OF THE

# Perthshire Society of Natural Science.

VOLUME I. PART III.

1882–83.



PERTH:

PUBLISHED BY THE SOCIETY AT THE

PERTHSHIRE NATURAL HISTORY MUSEUM.

MDCCCLXXXIII.

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# PROCEEDINGS

OF THE

# PERTHSHIRE SOCIETY OF NATURAL SCIENCE.

## SESSION 1882-83.

NOVEMBER 9th, 1882.

Colonel DRUMMOND HAY, C.M.Z.S., in the Chair.

NEW MEMBERS.

The following were nominated as ordinary members:—Mr Alex. Menzies, Rector of Webster's Seminaries, Kirriemuir; Mr William Cochrane Young, solicitor, Perth; Mr James Thomson, C.E., Edinburgh; Mr C. S. France, Balboughty; and Mr Athole Macgregor, Eastwood, Dunkeld. On the recommendation of the Council, Dr James Croll, LL.D., F.R.S., of H.M. Geological Survey, a distinguished native of Perthshire, was proposed as an honorary member.

DONATIONS.

It was intimated that the following donations had been received:—*Index Collection.* Minerals from Dr White and Dr Buchanan White; rock specimens, from Professor James Geikie and Dr Buchanan White; drawings, from Mr Ellison; Venus' flower-basket (a silicious sponge), from Mr J. Stuart, Cumbrae; various zoological specimens, from Dr Buchanan White, Messrs John Stewart, Jas. Stewart, Ellison, Gatherer, Keith, &c. *Perthshire Collection.* Birds' nests and eggs, from Dr Buchanan White, and Messrs Herd and Ellison; geological specimens, from Professor J. Geikie, Dr Buchanan White, and Messrs Crichton and J. Coates; insects, from Dr Buchanan White, and Messrs J. Stewart, Ellison, and Herd (particularly noticeable in this collection being a pair of Perthshire specimens of Deilephila galii from Mr John Stewart); shells, from Dr Buchanan White; plants, from Dr Buchanan White, and Messrs Coates and Herd; two nightjars, from Mr M'Intosh, Aberuchill; one do., from Mr James Keay, Murthly; one barn-swallow and one sparrow, from Dr Buchanan White; two merlin hawks, from Mr Alex. Stewart, Logiealmond; two dunlins and one ringed plover, from Mr J. G. Millais, Murthly; one perch, from Mr Speedie, Perth; one cuckoo and one sparrow-hawk, from Mr James Dow, Clathybeg; one common buzzard, from Sir Robert Menzies; one do., from Mr D. Watson, Castle Menzies; and one hare, from Mr George Gray, Bowerswell. The following donations were made by Mr P. D. Malloch, bird-stuffer:—Two long-tailed ducks; one black-throated diver; two ptarmigan; two knots; two water-rails; two red-throated divers; and one puffin. *Library.* Annual Reports of the British Association for the Advancement of Science; Report of Smithsonian Institute for 1880; and pamphlets, from Mr Patrick Geddes and Mr W. J. Harrison.

The Chairman exhibited, and presented as a donation to the Society, a specimen of hæmatite iron which was found upon the Binn Hill at Seggieden. He said that there had been a large quantity of these specimens found, and in consequence two or three years ago he asked Dr Geikie to come and look at the ground. He did come, and several places where he supposed there might be a vein of this hæmatite were turned up, but he did not succeed in finding any. In the ploughing of the fields specimens were frequently turned up, and there could be no doubt that there was a small vein somewhere in the locality. Dr Geikie was of opinion that there was about 75 per cent. of pure iron in the specimen.

The Chairman afterwards stated that Sir Robert Moncreiffe had deposited in the Museum a quail which was shot by Sir Thomas about 25 years ago, and Mr T. G. Harry Moncreiffe had also lent a little auk.

The following paper was read:—

"*The Present Condition of the Museum.*" By Dr F. Buchanan White, F.L.S.

The object of every Museum was, or ought to be, educa-

tional. Specimens ought to be arranged systematically, and bear more or less instructive labels. But beyond this something more was required in the way of an introduction or guide to the system of arrangement adopted, and it was with the view of supplying this that the author had been induced to prepare this paper.

As had been frequently stated before, the Museum consisted of two departments. One—the larger—was confined solely to the natural history of Perthshire and the basin of the Tay; the other was intended to form, as it were, an introduction to that, by showing in a small space what the scheme of creation, as interpreted by naturalists, was throughout the world. In the Perthshire collection the Society hoped eventually to bring together specimens of every animal, plant, and mineral that was to be found within the district; to classify them; and to label them in such a manner that as much instruction as possible might be conveyed to the student. This department, though the more important, and to naturalists in general the more interesting, required to be supplemented to carry out the scheme of making the Museum as powerful an instrument of education as possible. Perthshire, though no doubt large in their eyes, was after all but a very small part of the world; and its fauna and flora, though extensive, required supplementing if they were to show clearly the system of classification in natural history. They had, therefore, added to the Museum, but kept distinct from the Perthshire Collection, another collection, which might be termed the "Typical" or "Index Collection," which consisted of a few carefully-selected types of orms illustrative of every chief group in the animal, vegetable, and mineral kingdoms. The "Typical Collection" was contained in four table cases. These gave an area of about 174 square feet,—not very much in which to illustrate the subject, but still enough in which, with careful selection, a good deal could be done.

The first table case was devoted to geology, and one side of it was occupied by illustrative examples of mineralogy. The arrangement followed in this department was that of Dana's "System of Mineralogy." Dana, in the last edition of his work, gave about 900 species or forms of minerals, and, as illustrations of these, the Society had upwards of 300 specimens (some of them consisting of several examples) selected from the more important forms, and forming as good a typical collection of minerals as could be desired. In the labels attached to each the following particulars were given:—First, the name of the mineral; second, its crystallization (if crystalline); third, a brief indication of its chief constituents; and, fourth, the locality whence the specimen was derived. In selecting the typical minerals for this collection special attention had been given to the minerals more specially characteristic of the rocks to be found in Perthshire, though, of course, other important minerals had not been overlooked.

The other half of the table-case was occupied by a collection illustrative of petrology as distinguished from mineralogy. In other words, it was designed to show types of the chief rocks of which the crust of the earth was composed. The term "rock" was not, in the vocabulary of the geologist, restricted to the hard, stony formations which in common language were so called, but was applied to all the different layers, hard or soft, which went to form the earth's surface. Thus clay, sand, or gravel were geologically rocks.

In the next table-case there were a large number of specimens illustrating by characteristic fossils the stratigraphical arrangement of the sedimentary rocks. They also served to show the successive development of animal and plant life on the surface of the earth. These fossils—of which they had upwards of 300 kinds, and many examples—were arranged to show the order in which the rocks succeeded each other.

Having arrived at the end of the geological portion of the typical collection, they passed on to the cases containing illustrations of zoology or of the animal kingdom. The organisms which in classification went to form the animal kingdom were portioned out into what were termed sub-kingdoms, of which the lowest contained the animals which approached in structure the lowest representatives of the vegetable kingdom, and the highest those animals which possessed a backbone. The lowest sub-kingdom was that of the Protozoa, the boundary line between which and the vegetable kingdom was so vague and shadowy that it was a matter of opinion whether certain organisms sometimes placed in it were animals or plants. The great majority of the Protozoa were of minute size, and lived either in salt or fresh water: and as it was impossible to show specimens of the creatures themselves, they would be represented by drawings or models, or, in the case of the shell-bearing groups, by their shells. The illustrations at present consisted of drawings of animals—very much magnified—belonging to the sub-divisions of each of the three great classes into which the sub-kingdom had been divided.

The second sub-kingdom was that of the Cœlenterata. The animals belonging to it were all aquatic, and had, unlike the Protozoa, a distinct body cavity, but they had no proper intestinal canal. These would be illustrated by means of models, the group being a very difficult one to illustrate by the animals themselves.

Another sub-kingdom was that of the Mollusca, which included, in addition to slugs, snails, whelks, oysters, cuttlefish, &c., the various sea-mats and their allies.

After briefly alluding to the sub-kingdoms Echinodermata and Vermes, the author passed on to the Arthropoda, which contains all the animals without backbones, and which have legs with joints. To this sub-kingdom belonged all the insects; crabs, lobsters, and other shell-fish; scorpions, spiders, mites, &c.; and as many of the animals belonging to it were terrestrial, and hence represented in our own district, more space had been allotted to it than to some of the other sub-kingdoms. In the latter part of the paper the various orders of insects were enumerated and described. The author reserved for another occasion his remarks as to the typical collection illustrative of the backboned or vertebrate animals, as well as the botanical type collection.

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DECEMBER 7th, 1882.

Dr BUCHANAN WHITE, F.L.S., in the Chair.

NEW MEMBERS.

The following new members, proposed at last meeting, were unanimously elected:—Mr Alex. Menzies, Rector of Kirriemuir Seminaries; Mr W. Cochrane Young, solicitor, Perth; Mr James Thomson, C.E., Edinburgh; Mr C. S. France, Balboughty; Mr Athole M'Gregor, Eastwood, Dunkeld; and Dr Calder, Perth. Dr James Croll, F.R.S., was elected an honorary member. Mr Samuel L. Condall, Perth; and Mr Robert Keay, Assistant City-Clerk, were nominated for election as ordinary members.

DONATIONS.

The following donations were intimated:—*Perthshire Collection.* Insects, from Mr John Stewart, Mr John Bruce, Mr P. D. Malloch, and Mr George Alexander; and a large number of plants, from Mr C. M'Intosh, Inver. *Index Collection.* Zoological specimens, from Mr P. D. Malloch.

Mr James Stewart presented a disarticulated skeleton of a bird to the Society, and exhibited the skeleton of a mole, and explained the structure.

"PROCEEDINGS."

Part II. of the Society's Proceedings and the catalogue of the books in the Library were laid on the table.

The following paper was read:—

"*Light.*" By Thomas Miller, LL.D., F.R.S.E., Rector Emeritus of Perth Academy.

The sun might be considered the sole source of light and heat, and indeed of all physical change in our system except the tide of the ocean, of which the attraction of the moon was the principal cause, but even in that the sun had a considerable influence, while the amount of light and heat which it diffused through space was great beyond conception, and the intensity of its light was exceedingly great. The sun gave as much light as 146 lime-lights, and the earth intercepted only a small portion of it and the sun's heat. The dissipation of energy in the case of the sun was prodigious, and the portion intercepted by the earth was sufficient to melt annually a shell of ice 30 metres, or 105 feet, thick, surrounding its whole surface. As to the restoration of the sun's energy, the author shewed that it could not be by combustion, and afterwards spoke of the meteoric hypothesis, in connection with which he gave some very interesting calculations, from which it appeared that if there were a sufficient number of meteors in the vicinity of the sun, these would maintain its heat and light by continually impinging on its surface, while its increase in magnitude would be so small that we could not detect it by even our finest instruments, although this process were to go on for 4000 years. But that there was not the necessary number of meteors near the surface of the sun was proved from the circumstance that comets approached very near it in their perihelion passages, and the movements in their orbits were not in any degree affected.

It being therefore obvious that the fall of meteors could not account for the phenomena, they were compelled to have recourse to the hypothesis of Sir William Herschell and La Place, viz., that the solar system existed at one time as a vast nebula; that it gradually contracted by the force of gravitation, and in doing so evolved much heat and light; that this nebula had a revolution on its axis from west to east, and that it threw off by its centrifugal force various rings, which afterwards formed the planets Neptune, Uranus, Saturn, and Jupiter; that the ring between Jupiter and Mars, having had no preponderating mass in any part of it, broke up into a vast number of small bodies called planetoids, such as Vesta, Juno, Ceres, Pallas, &c.; that the next ring produced Mars, the next the earth, the next Venus, and the last Mercury; that the satellites were similarly formed; that all these existed during unfathomable ages in a state of intense incandescence, many times hotter than iron at a white heat; that the satellites, being comparatively small bodies, cooled first, and

afterwards their primaries; that Jupiter, Saturn, Uranus, and Neptune, from their great size, were still too hot to support organic beings; and that the sun, having been formed by the rushing together of enormous masses, and from its great size, was still, and would continue for unfathomable ages, inconceivably hot,—so hot, indeed, that iron at a white heat was cold compared to it.

The sun, however, must gradually cool, and in doing so diminish in size; but the heat and light evolved by its condensation would be sufficient to make up for its emission for millions of years. A diminution of one ten-thousandth part of its diameter could not be detected by our finest instruments, and that would cover its total emission for 2100 years. It was obvious, however, that the energy of the sun must ultimately be exhausted; and although this might be partially restored by the fall of meteors and planets into its body (as was proved by the motion of Encke's comet they must ultimately do), the sun, having the whole bodies of the system welded into its body, must at length revolve through space a cold, dark, and lifeless mass, until it came into contact with some large body like Sirius, when the heat produced by the impact of such enormous masses would be sufficient to convert both into vapour, which would form a nebula, from which, in the course of ages, a greater and more glorious system than the present would be evolved.

Dr Miller afterwards spoke of the velocity of light, the best method of calculating which, he said, was by making observations on the transit of Venus over the sun's disc. The discovery of Mitchelson (who found the velocity of light to be 186,380 miles per second) was published in 1879, and he had no doubt it would be tested by the observations made on the trausit of Venus this year; and as astronomical methods and instruments had been greatly improved, a correct result might be reasonably anticipated. In the meantime they might assume 186,000 miles per second as the velocity of light. That light was not propagated instantaneously was proved by Dr Bradley iu 1728 by his discovery of the aberration of the fixed stars.

The author next adverted to refraction, which was one of the most valuable properties of light, as without it we should neither have lenses for correcting our imperfections of vision, nor microscopes for scanning the minute arcana of Nature, nor telescopes for exploriug the distant regions of space, nor even the eye itself. Having referred to the many ordinary and extraordinary atmospheric phenomena which were easily explained by refraction, the lecturer proceeded to state that if a ray of the sun were admitted into a dark chamber, through a small aperture in a window-shutter, and made to pass through a glass prism, there would be obtained on a white screen an elongated image consisting of seven different colonrs—red, yellow, orange, green, blue, indigo, and violet. This was called the solar spectrum. When the light of the snn was properly decomposed, it was found that the coloured spaces in the spectrum were not continuous, bnt that they were furrowed by about 2000 dark lines parallel to the axis of the analysing prism. These lines did not follow each other with any degree of regularity, but they always retained the same position for the same kind of light, independently of the material of which the prism was composed, and the size of the refracting angle. They differed, however, in number, size, and arrangement for different kinds of light; and Professors Kirchkoff and Bunsen had demonstrated that they were the result of metals existing in a gaseous form in the solar atmosphere, as they produced the same lines in the electric spectrum by applying iron, calcium, sodium, magnesium, and chromium to the carbon points, and then making the light thus produced pass through an atmosphere of the vaponr of the same metals before it fell on the analysing prism. They thus proved that a gas or vapour absorbed those precise rays which it could itself produce.

The discovery of spectrum analysis, made by Professors Kirchkoff and Bunsen, was next, after the dynamical theory of heat, the most important of the present century. By it we were made acquainted, *inter alia*, with the constitution of the sun, planets, fixed stars, and nebulæ. Of the thirty-six known metals, seventeen had been discovered in the sun's atmosphere; and were it not that our atmosphere was so unsettled and the lines of the rest so faint, there was no doubt the rest would be discovered also. The sun was thus proved to be of the same matter as the earth; and as the spectra of the planets contained the same dark lines as that of the sun, it followed that they were opaque dark bodies shining by reflecting the sun's light. Those fixed stars also on which correct observations had been made were proved to consist of nuclei in a state of iutense incandescence, surrounded by atmospheres in which, like that of the sun, metals existed in a state of vapour. By spectrum analysis also we were enabled to discover the constitution of nebulæ, and to ascertain whether a star was approaching or receding from the earth, and with what velocity.

But it was not only in researches in astronomy that spectrum analysis had proved so valuable. Several metals, the existence of which was not even dreamed of, had

been discovered by its means, such as rubidium, cæsium, and thallium; and its application to the manufacture of steel by the Bessemer process had enabled us to obtain that important article of commerce in much abundance, and at a low price.

As to the nature of light, two theories had been propounded on this subject. One was that light consisted entirely of indefinitely small particles which were projected from the sun and other luminous bodies, in straight lines, in all directions, with incredible velocity. As it was supposed by this theory that a substance escaped from the luminous body, it was usually called the theory of emission or emanation, and sometimes the corpuscular theory. The second hypothesis was usually called the undulatory theory, according to which the universe was supposed to be filled by a very subtle substance called æther, which penetrated everywhere, and which we were unable to perceive so long as it remained at rest. A luminous body caused it to enter into undulations similar to those of the air when sonnd is produced. Both the undulatory theory and that of emission enabled us to explain the ordinary phenomena of optics, such as reflection, refraction, &c., and so far it was difficult to shew any superiority which the one had over the other; but when we proceeded to diffraction, polarisation, &c., we were compelled to renounce the former and embrace the latter. He did not know of any one whose opinion was worth noticing who adhered to the theory of emission.

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## January 4th, 1883.

Mr Robert Pullar, F.R.S.E., Vice-President, in the Chair.

### NEW MEMBERS.

Mr Samuel L. Condall, South Tay Street, and Mr Robert Keay, Assistant City-Clerk, were elected members; and Sir Robert Menzies of Menzies, Bart.; Rev. Mr Stevenson, Middle Church; Mr D. R. Irvine, Perth Brewery; Messrs James Bridges, *Perthhire Advertiser;* F. P. Carnegie; James Kaye, Balhousie School; William Barclay, Watergate School; and J. S. Cruickshank, were nominated for election. Dr Andrew Wilson, F.L.S., Edinburgh, was nominated for election as a corresponding member.

### DONATIONS.

The following donations were intimated:—Fox killed near Coupar-Angus, from Mrs Archibald Coates, Paisley; two black and two red grouse (male and female), from Sir Robert Menzies; one blackbird (female), two red-wings (male and female), and a wasp's nest, from Colonel Drummond Hay of Seggieden.

### AUDITORS.

Mr Henry Coates and Mr Robert Keay were appointed auditors of the Treasurer's accounts.

The Secretary read the following obituary notice of the late Mr John Sadler, Curator of the Royal Botanic Gardens, Edinburgh, communicated by an old member of the Society:—

John Sadler, curator of the Royal Botanic Gardens and Arboretum, Edinburgh, who died upon the 9th December last, although born in Fifeshire, came at a very early age (when he was about a year old, I think) with his family to Moncreiffe, where his father had been appointed gardener. His first education was received in Dumbarney Parish School, and latterly he attended the Seminaries, Perth. About the year 1854, his family removed to Edinburgh, and about that time, or shortly before, he was sent to Bristol, where he entered the employment of an uncle, a general merchant in that town, who, if I understood aright, was said to be the type from which Dr Smiles drew his character of the "Successful Merchant." Mr Sadler's engagement there appeared not to suit his tastes, for in a very short time he returned to Edinburgh, and entered the Botanic Gardens, where he remained till his death. He was then about 17 years of age. In this new sphere of life, he had the very best opportunities for cultivating his taste for botany, which had no doubt been early implanted in his mind, when in childhood he was playing in the gardens and wandering through the woods of Moncreiffe. As assistant to the Professor of Botany, he was brought continually into contact with the various phases of botanical knowledge, from its most rudimentary stages to the most abstruse and complex questions; while his association with some of the most advanced students was the means of affording him the most recent, full, and accurate information in all the branches of his science. Although the sources of knowledge were thus so easily within his reach, and although the acquiring of it seemed to be more of the nature of a pastime to him than a hard study, he does not seem to have been content to take it all from second hand, for he was a shrewd observer, and was fortunate enough to contribute original matter by several new discoveries. It is more from his manner,

than from the results of his studies, that I am inclined to think his work sat so lightly on him, for he had a happy and seemingly careless way of getting over the dry details in the nomenclature, structure, and characters of plants,—often playing facetiously on some crack-jaw name, or joking on some peculiar feature of the construction or popular virtue of a plant; while one felt that under all the nonsense he talked, there was always a vein of valuable truth. Mr Sadler was for many years an important figure in Professor Balfour's botanical excursions with his students. To the Professor's enthusiasm he added the geniality of a youthful and boisterous spirit, and the group of students which gathered around and followed him, clustering together like bees to learn the name and order of some rarity that had been picked up, was nearly as conspicuous as the group which followed and gathered its information from the learned Professor himself. Mr Sadler was very popular as a lecturer on his favourite science. As a speaker he was at first rather rough, and wanting in cultivation, but his language and manner greatly improved by practice. The chief and most attractive feature of his speaking, however, was the simplicity and ease with which he was able to communicate his information, and the familiar and happy way in which he made an otherwise dry and uninviting subject plain and interesting to a popular audience. Mr Sadler's connection with the Perthshire Society of Natural Science dates from about its commencement in 1867. He became at once an ordinary member, although residing at a distance. The desire, so far as I can recollect, of the originators of the Society, was that he might be chosen a corresponding member, in the hope of getting, through his interest in a Perthshire Society, some assistance in the way of papers, or contributions of articles for the herbarium and museum; but instead of that honour, he claimed, on account of his close friendship with some of the members, and of his being a Perthshire man, a right to the privileges of a full ordinary member. He was accordingly elected an ordinary member, the first on the list after the original members; but he does not seem to have done very much work for the Society. Subsequently he was elected a corresponding member. In the early years of the Society two conversaziones were held in the City-Hall, both of which were looked upon at the time as great successes; and at both of these Mr Sadler attended and took part in the proceedings. Mr Sadler did much work for the Edinburgh Botanical Society and the Scottish Arboricultural Society, and his name will always be remembered by Scottish botanists in connection with the plants *Salix Sadleri* and *Carex frigida*, which he discovered on the Braemar mountains. Mr Sadler's comparatively early death has saddened a large circle of friends, and his loss must be of considerable importance to the departments under which he held his official appointments, and where his ability appears to have been highly valued.

The following paper was read:—

"*Autumn Tints; Their Why and Wherefore.*" By Mr Henry Coates.

To the student of nature each season of the year is full of deep interest, and each furnishes him with abundant material for investigation. But to the botanist spring and autumn are the seasons of special interest. They set him thinking of the wonderful changes which take place in the plant world at the opening and closing of the year—changes on which depend the life and growth of all the plants around him, and which yet are carried on so gradually and silently as to be almost unnoticed except by the close observer. With such thoughts as these his mind will be particularly busy as he wanders through the woods and meadows in the end of September and beginning of October. Most naturalists, I think, have an artist's appreciation of the beauties of form and colour in the objects they study. Those who have this gift of appreciation will revel in the wealth of rich colouring and mellow shades presented by our woods and fields during the months I have named, and in the infinite variety of tint to be observed in each individual leaf.

It is interesting to note the different tints assumed by various trees, which we may easily do in the course of a walk up the banks of the Tay, or by climbing Moncreiffe or Kinnoull Hill. The horse-chestnuts are conspicuous by their large leaves of bright yellow, contrasted by the deep green of those which are yet untinted. For reasons which will presently be apparent the leaves at the top of the tree and at the extremities of the larger branches are those which first change their colour. The sycamores are brilliant with blended tints of yellow and red, while the beeches have assumed a more sombre colouring of russet brown. The most brilliant hues to be observed in our native trees are those of the mountain ash, whose leaves turn a bright crimson, but even these are outrivalled by those of the American maple, which has been introduced into many parts of this country. Where the trees have been of the most vivid green in summer, such as by the banks of streams and in rich soil, the autumn tints are the most brilliant, though not the first to appear,—trees in exposed situations generally changing their colour earliest.

They are also affected by the season—bright and sunny weather tending to intensify the tints. The autumn colouring of the deciduous trees is beautifully contrasted and relieved by the dark green heads of the pines which over-top the rounded summits of the former. It is not, however, to the trees alone that we have to look for brilliant colours—the ground is carpeted with fallen leaves, where their tints, sombre and gay, are beautifully mingled together; and peeping through these are the plants, whose flowers in the by-gone summer made the woods bright with many colours, and whose leaves now serve the same end with more mellow tints.

All these effects of colour we have observed and admired many times in our autumn rambles, but have we asked ourselves, What are they caused by? How is it that with the first sign of approaching winter, the uniform green forsakes the leaf and is replaced by red and yellow and brown? And why, after a brief display of these brilliant hues, does it wither and drop off from the branch? Before trying to answer these questions, it may be well to look briefly at what a leaf is, and at the work it has to do for the plant to which it belongs—in other words, at the anatomy and physiology of the leaf.

Looked at with the naked eye, the first feature that strikes us is that the surface is traversed by a number of lines or veins. These are, in fact, the continuations of the fibres, or bundles of vessels, of which the leaf-stalk is composed, sub-divided in order to be distributed throughout the leaf. Their use we shall learn presently. If we now make a very thin tranverse section of the leaf—that is, from the upper to the under surface—and examine it under a microscope, we shall find that it is entirely built up of minute closed sacs or cells arranged in a certain characteristic manner. Those on the two surfaces are more or less oblong in shape, small, and placed side by side quite close together so as to form the outer skin or *epidermis.* Next to these are layers of small rounded cells, packed tolerably closely together, while the central tissues of the leaf are made up of considerably larger cells, which are round and arranged very loosely, so as to leave air spaces between them. Imbedded in this spongy central mass are the bundles of *vessels*, as they are called, which constitute the veins. These vessels are modified cells, very much elongated, and placed side by side so as to form a continuous series. They, as well as the cells forming the thin outer skin, are perfectly colourless, but the other tissues appear as though coloured green on account of the minute particles of green matter, called *chlorophyll*, which they contain. If we now peel off carefully a very thin portion of the outer skin of a smooth leaf and place that under the microscope, we shall see the colourless empty surface cells under a different aspect, and scattered throughout these will be observed a number of minute openings or slits, each guarded by two crescent-shaped cells, specially adapted for the purpose. These little mouths, of which there are countless numbers on one or both surfaces of most leaves, are called *stomata*, and they play a most important part in the economy of the plant.

Such is a very brief sketch of the structure of a leaf. We shall now glance at the various functions which it has to perform for the living plant. Of these, perhaps, the first in importance is respiration, or, as it is more correctly termed, *assimilation.* So long as a plant is exposed to the light, its leaves are constantly taking in carbonic acid gas from the atmosphere, and, by the aid of the green colouring matter contained in its cells, separating this gas into its two constituent elements—namely, carbon and oxygen. The carbon it appropriates to its own use, for the purpose of building up the tissues of the plant, which, as you are aware, chiefly consist of carbon in combination with one or two other elemenst. The oxygen, on the other hand, which has been disengaged from the carbonic acid, is returned to the atmosphere. This process, it will be observed, is exactly the converse of what takes place in animal respiration; but, in the dark, certain parts of plants are also found to absorb oxygen and give off carbonic acid. How the leaf actually disengages the carbon from the carbonic acid we cannot tell. All we know is that two conditions are necessary to the process—namely, light, and the presence of green colouring matter or chlorophyll. In thus absorbing from the atmosphere the gases necessary for the life and growth of the plant, the leaves may be said to be the breathing organs or lungs of the plant.

Another important function of the leaf is that of evaporation, or *transpiration*, as it is termed. This process corresponds to perspiration in the animal world, and is carried on by the agency of the little mouths or "stomata," which we observed in the skin under the microscope. It is evident from many observations that there is a constant circulation of water throughout a living plant, and that, without this, its life cannot be maintained. If a plant growing in a flower-pot is neglected to be watered, in the course of a few hours it begins to droop, and ultimately withers and dies. The reason, of course, is that its tissues have ceased to be distended by the moisture with which every growing part of a plant must be supplied. But if this be so, where has the moisture with which it was last supplied gone to? The answer is, that it has evaporated or "transpired" through the

stomata of the leaves. This effect is made apparent if the plant is growing uuder a bell glass, for then the moisture which has been given off settles on the inside of the glass in the form of visible vapour. It is thus evident that there is a constant though gradual current of water passing through the living plant from the rootlets which absorb it from the soil to the leaves which give it off into the atmosphere. When a plant droops during dry weather in summer, it is because the moisture is given off from the leaves in greater quantity than it is taken up by the roots. But counterbalancing this result, which would soon prove fatal to the plant, is a provision which causes the stomata to close when necessary, and thus to regulate the amount of evaporation. In moist weather the stomata-cells are inflated with water, but in dry weather they lose this water and so collapse and close the openings. The leaves then perform also the work which, in the animal, is performed by the skin.

The next work of the leaf—namely, that of elaborating the sap, and preparing it for the nourishment of the plant —is closely connected with the two processes which I have already described. For the sake of simplicity, we shall take as an example one of our forest trees, such as the oak, and try to trace the course of the sap in it. In spring, we find it ascending into the leaves through the vessels contained in the outer or newest layers of wood in the form of a thin sweetish liquid. When it is in the leaf, it is exposed to a variety of influences, which affeet a material change in its chemical constitution. The carbon—which, as we have seen, is always being absorbed by the leaf—combines with the other substances drawn up with the sap from the soil, and thus starch and other organic compounds necessary for the nutrition of the plant are formed. Then, by the transpiration which takes place from the leaf, the sap loses a considerable portion of water, and so is rendered denser and more concentrated. By these means, when it returns from the leaf, it has beeome a thick viscid liquid, and in this form it starts on its course throughout the plant, to fulfil its mission of nourishing and building up its tissues. Thus it comes about that, in autumn, we find the sap slowly *descending* the stem of our oak tree through the vessels contained in the innermost layer of the bark, and, as it proceeds, building up, on the one hand, a new layer of wood, and, on the other, a layer of bark, or, in other words, adding another to the "rings" which we have all observed in the exposed section of a felled tree, It is this descending sap which the American backwoodsman collects when, in the fall of the year, he taps the trunk of the maple tree for its valuable sugar. If we wish to prove the wood-forming property of this elaborated sap, we may do so by a simple experiment. If we bind a hoop of iron very tightly round the stem of a growing tree in the beginning of autumn, we shall presently observe a bulge or growth beginning to be formed above this band, showing that the sap, unable to descend to the lower part of the stem, is exerting its energy, so to speak, in forming new woody tissne at the point where its course is arrested. The work which the leaves do in elaborating the sap is analagous to the process of digestion, so that they may be said to constitnte also the stomach of the plant. It will now be understood that this process of elaboration is simply the two processes first described looked at in a different aspect.

It is perhaps carrying the analogy of the animal a little too far to say that the leaves constitute the heart of the plant, and yet when we come to investigate the physical laws which cause the sap to ascend the stem of a tree against the force of gravity, we find that the idea is not so far-fetched. For what does a heart, or at least the left side of it, do? It propels the blood or nutritious fluid throughout the body of the animal, while the leaves perform precisely the same work for the plant, though upon a very different mechanical principle. What this method is it would take too long to explain here, but I will merely ask you to bear in mind that the sap is not conducted through a continuous open tube, but through the walls of an infinite number of closed vessels which form the fibres of the veins, leaf-stalks, branches, and stem.

To sum up the physiology of the leaf in its normal condition, it may be said to perform for the growing plant those functions which in the animal are performed by lungs, skin, stomach, and heart. This illustrates the fact, which it is well to remember, that one fundamental physiological difference between an animal and a plant is that in the former the vital processes are carried on by means of individual specialised organs, which are complete in themselves and distinct from the other organs; while in the plant these processes are carried on by a countless number of similar organs disseminated throughout the entire structure. Thus the oak we have been examining has not one pair of lungs, but breathes by the entire snrface of every leaf—it has not one heart or one stomach, but as many, metaphorically speaking, as it has leaves. We might go farther, and point out how every one of the myriad green or chlorophyll-bearing cells in the leaf is a distinct organ of nutrition which acts independently of, and equally with, every other such cell. This distinction is applicable particularly to the more highly-developed branches of the two great divisions of the organic world, for in the lowest forms in both, the types approach much more closely to each other.

Such, then, is a history of the work with which the leaf has been busy all summer ; let us see now what becomes of it in autumn. All through the season the sap has been coming into it to be made fit for the nourishment of the plant, but by this process not only the sap but the leaf itself has been constantly undergoing a change. The sap comes into it charged with mineral matters, which were dissolved in the water drawn up by the rootlets from the soil. But when it is in the leaf it suffers, as we have seen, a certain amount of evaporation, and it is therefore obliged to lose a portion of its mineral contents, which is then deposited in the vessels of the leaf-stalk and veins. Thus it comes about that, by the end of the season of activity, these vessels become entirely choked with this deposit, and from this two results follow. On the one hand the upward flow of the sap is gradually arrested, and, on the other, the leaf fades and dies for lack of moisture and nourishment. It is at this point of its history, when its work is almost finished, and just before it falls from the tree, that it assumes its autumnal colouring. The actual chemical change which then takes place is due to a variety of causes which are not yet clearly understood, but this we know, that all the varied shades of red, crimson, yellow, and brown are produced by the same substance which made the leaf green in summer—namely, chlorophyll, though in a slightly altered form. The change which has taken place in its chemical constitution is mainly due to the loss of protoplasm, starch, and other substances which have been withdrawn from the cells of the leaf into the bark and branches of the tree. Two circumstances occurred to me while watching the progress of the tints last autumn, as tending to confirm this hypothesis. The first was that in each leaf the first parts to change colour were those farthest from the veins ; while, in the second place, the first leaves on the tree to become tinted were always those at the summit and at the extremities of the larger branches. These, it will be seen, would be the first parts of the leaf and of the tree to be affected by such a withdrawal. In connection with this Mr Grant Allen remarks in his delightful sketches, entitled *Vignettes from Nature*, that some of the autumn tints "Are actually present in the green leaf itself, though completely masked during the period of vigour by the preponderance of the natural pigment which owes its colour to the due admixture of them all." In this withdrawal we may observe a most beautiful provision of Nature for the sustenance of the plant, for if these stores, which the leaf has been at such pains to manufacture, were not thus withdrawn, they would be sacrificed and wasted when the leaf falls. As it is, however, they are carefully stored up in the tough tissues of the tree for its use during the winter months, and for the nourishment of the young buds in spring before they are exposed to the light, and so enabled to obtain air-food for themselves.

At the same time that the leaf is assuming its autumn colouring, another change is taking place, also preparatory to its ultimate separation from the branch. If you examine the scar which is left on the latter after the leaf has fallen from it, you will observe that it is not ragged, but as smooth as if the leaf-stalk had been cut off with a sharp knife; and farther, this scar, even immediately after the leaf has been shed, is perfectly dry, showing that no sap or moisture is escaping from the ends of the severed vessels. The reason of this is that with the approach of autumn the set of cells which form the junction of the leaf-stalk with the branch gradually shrivel up, so that when the work of the leaf is finished, and after it has delivered up all its stores of nourishment to the parent tree, it gradually fades and dies, and then gently falls from the branch, either by its own weight, or the touch of the autumn breeze. In this way Nature anticipates the fall of the leaf, and makes provision that no particle of plant-food should be lost by bleeding, such as would result were the leaf left to be torn off by the wind. The precise nature of the change which takes place in these junction cells is still a matter of dispute among botanists.

Before leaving the autumn leaf, we may point out the end which it has to fulfil in the economy of Nature after it has fallen to the ground. You are all aware what valuable mould is produced by the decay of fallen leaves. The reason of this is simply the large amount of mineral matter contained in their tissues, and which, as we have seen, was the cause of their death. In this we have a further illustration of how none of Nature's products are wasted, for part of this mineral matter which is necessary in one stage of the plant's growth, but would be injurious in another stage, is arrested by the leaves and by them returned to the soil to assist in the fresh growth which is to take place next spring.

Such are some of the thoughts which are suggested by the autumn woods, when, in the words of the author of the *Christian Year*, we

> Watch the calm leaves float,
> Each to his rest, beneath their parent shade.

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FEBRUARY 1st, 1883.

R. PULLAR, Esq., F.R.S.E., Vice-President, in the Chair.

NEW MEMBERS.

The following members were elected : — Sir Robert Menzies, Bart.; Mr James Bridges, City Treasurer ; Mr F. P. Carnegie ; Mr Cruickshank, St John Street ; Mr Kaye, Balhousie School ; Mr Barclay, Watergate School ; Mr D. R. Irvine, Perth Brewery ; and Rev. William Stevenson, Middle Church.

The following were nominated for membership :—Mr James Sellar, Tay Street ; Mr Thomas Ferrier, Melrose Villa, Kinnoull ; Mr Mackie and Mr MacQueen, of Perth Academy.

NOMINATION OF OFFICEBEARERS.

The following gentlemen were nominated as officebearers for the ensuing year:—President, Colonel Drummond-Hay; Vice-Presidents, Mr John Stewart, Mr Magnus Jackson, Mr Smythe, yr. of Methven, and Mr S. T. Ellison ; Secretary, Mr John Young, C.E. ; Treasurer, Mr John M'Gregor; Curator, Colonel Drummond-Hay ; Librarian, Mr James Coates; Editor, Dr Buchanan White; Councillors, Mr P. D. Malloch, Mr John Campbell, and Mr A. Sturrock, Rattray.

DONATIONS.

The following donations were intimated : — Greater black-backed gull, from Lord Stormont; insects, from Mr W. Herd (notably a fine series of the rare *Eupithecia togata*); a large collection of plants, from Mr C. M'Intosh, Inver ; ptarmigan in winter plumage, from Sir Robert Menzies, Bart. ; drawings of plant-structure, from Miss Drummond-Hay of Seggieden; skull of whale, from Mr Gatherer; drawings, from Mr William Ellison ; hedgehog, from Mr J. Grant, Tullymet ; cast of *Pterygotus anglicus*, from the Dundee Naturalists 'Society (being from the very fine specimen found at Carmylie, and now in their Museum).

A paper was read—

"*On the Perpetuation of Plants*," by the Rev. Thomas Brown, Collace,

in which the author briefly alluded to some of the methods by which plants are reproduced.

MARCH 1st, 1883.

*ANNUAL MEETING.*

Colonel DRUMMOND HAY, C.M.Z.S., President, in the Chair.

NEW MEMBERS.

The following new members were elected :—Mr W. Mackay, Perth Academy ; Mr William M'Queen, Perth Academy; Mr T. Ferrier, Melrose House. Kinnoull ; and Mr James Sellar, Tay Street. The following gentlemen were nominated for membership :—Mr Samuel Walker, Sharp's Institution; and Mr John Sinton, Cherrybank.

DONATIONS.

The following donations were intimated :—Conglomerate cones of Scotch fir and two specimens of the fungus, *Polyporus applanatus*, sent by Mr John Macgregor, forester to the Duke of Athole, Dunkeld; various donations to the Type Collection from Dr White and Dr Buchanan White; black-tailed godwit, from Mr Horace Skeete ; common snipe and jack-snipe, red-start, willow-wren, meadow pippit, lesser redpole, three dunlins, redshauk, and cuckoo, from Colonel Drummond-Hay, who also gave on loan a wax-wing and pied blackbird; two mountain linnets, reed bunting, common tern and partridge, from Mr J. A. G. Drummond Hay; brambling and two brown linnets, from Mr P. D. Malloch; pair peregrine falcons, from Sir Robert Menzies; tawny owl, from Mr M'Lean, Murie House; pair land rails, from Mr William Hill, High Street ; pair robins, from Mr Dawson, Witch Hill; three snowflakes, one blackheaded bunting, and one greenfinch, from Mr James Dow, Clathiebeg; one mountain finch, two snowflakes, one sky lark, and two red linnets, from Mr P. D. Malloch; two snowflakes, and one blue tit, from Mr James Scott, Methven Castle ; one jack snipe, from Mr William Duncan, Balgowan; one heron, from Mr John Young, Tay Street, Perth ; pair ptarmigans, from Mr William Gow, Taymouth Castle ; two weasels, from Mr Henderson, Lethern ; fox, from Sir Robert Menzies ; three swau's eggs, one dipper, and one watervole, from Mr J. M'Donald, Rannoch ; white hare, from Sir John Stirling-Maxwell ; two long-eared owls, from Mr David Young, Freeland ; two weasels, from Mr James Scott, Methven Castle ; one weasel, from Mr G. Young, Freeland.

REPORT OF THE COUNCIL.

The Council, in presenting the Sixteenth Annual Report, has much pleasure in congratulating the members on the continued prosperity of the Society.

During the past session six ordinary meetings were held, the average attendance at which was 17. At these meetings six papers were read, the number of authors being six. These statistics show that there is still room for improvement with respect both to the attendance at the meetings and to the number of members who take an active part in them. As complaints have been made that members are apt to forget the dates of the meetings, your Council has arranged to try the experiment of sending out special notices of each meeting, which it is hoped will have the effect of increasing the average attendance.

During the past year four long excursions were successfully conducted—namely, to Logierait, Doune and Blairdrummond Moss, Glenartney, and the lochs near Blairgowrie. At these excursions several interesting additions to our knowledge of the natural history of Perthshire were made.

While the Society has added to the roll during the past year 49 ordinary, 1 honorary, and 1 corresponding member, several more or less intimately connected with the work of the Society have been removed by death. Amongst these may be noticed Mr Henry May, Governor of the General Prison for Scotland, who, though not a professed naturalist, always manifested a warm interest in the work of the Society, and by whom the Museum was enriched by several rare specimens; and Mr John Sadler, Superintendent of the Edinburgh Royal Botanic Gardens, who was the first elected member of the Society. The Council has also to notice with regret the removal from the district—by reason of his appointment to the Chair of Geology in the University of Edinburgh—of Dr James Geikie, to whom the Society is is indebted for many valuable services.

The total number of members of the Society is now 271, consisting of 258 ordinary, 2 honorary, and 7 corresponding members, and 4 associates. There are still, however, many persons in Perthshire who might be willing to join the Society if its claims were brought before them. The Council would, therefore, again urge upon members the desirability of calling the attention of their friends to the many advantages which the Society offers.

The arrangement of the Museum is being satisfactorily carried on, and it is hoped that it may be sufficiently advanced as to admit of a public opening taking place in the beginning of next winter. In the meantime, the Museum is open to the inspection of members.

Amongst other events of the past session may be mentioned the course of very successful Combe Lectures on Physiology (the local arrangements for which were made by our Society in conjunction with the Literary and Antiquarian Society) delivered during the past winter. Allusion may also be made to the fact, that the use of our lecture-room has again been given for several courses of lectures delivered to the Ladies' Educational Association.

## REPORT OF THE TREASURER.

The Treasurer (Mr John Macgregor) submitted a statement of the accounts for the year ending December 31st, 1882, from which it appeared that the amount of income was £96 7s 7d, and expenditure £60 1s 9d, leaving a balance in hand of £36 5s 10d. The Treasurer also reported that there were 45 members in arrears with their subscriptions, 38 of these were old members, and 7 new ones; and the Treasurer hoped that they would see their way to have these cleared off as soon as possible. He also begged to remind members generally that their subscriptions for the current year were due on the 2d April, and should be paid to him immediately thereafter, as agreed upon by the Council. The annual subscription for old members was now 5s 6d, which included the price of a copy of the "Proceedings;" and for new members 8s for first payment, and 5s 6d after.

## REPORT OF THE LIBRARIAN.

BY MR JAMES COATES.

By no means the least gratifying result of the occupation of the new premises is that the Society has now been enabled to institute its Reading-Room, to establish its Library on a most satisfactory basis, and to provide them with every thing necessary for placing them in efficient working order. On the table in the Reading-Room will be found the leading Natural History periodicals, and many of the publications of sister Societies, not only in this country, but on the Continent and in America. These the members are free to consult at all hours when the Reading-Room is open.

The work of arranging and cataloguing the Library has now been completed, and copies of the catalogue have been sent to the members. At the commencement of the catalogue will be found a list of the rules which regulate the issue of books, and it is desirable that members, in making use of the Library, should study these and observe them. The volumes at present number about 350, and additions are from time to time being made. This number may not appear large, but it must be recollected that the Library is not a *general* one, but is devoted exclusively to the collection of those works which bear upon the subject of Natural History, and, *as such*, the Society has reason to congratulate itself upon possessing a Library so complete and comprehensive.

The Library is divided into two sections—the Reference and the Lending Library. The Reference Section consists chiefly of standard monographs on almost every subject within the range of Natural Science, and these are reserved for consultation on the premises. The books contained in the Lending Section are intended for circulation among the members in the usual way. The majority of these books have been acquired within the last year,—partly through purchase by the Society, as in the case of the publications of the Ray Society, the works of Charles Darwin, &c.; and partly through presentation. To the British Association for the Advancement of Science, the Smithsonian Institute, &c., the Society has to record its thanks for handsome donations to its Library.

It only remains for the members of the Society to take full advantage of the opportunities thus afforded them. By referring

to the catalogue, it will be found that, while it contains those works of a more strictly technical nature which are of interest chiefly to practical workers in the different branches, there are also not a few of general, and even popular, interest, from which all may derive instruction in an attractive form.

### REPORT OF THE CURATOR.

Colonel DRUMMOND HAY stated that the arrangements in the several departments of the Museum are going on steadily, though slowly, as the workers are few. Amongst vertebrates, the birds make the most show, but, as is the case both with them and the mammals, there are several species that would be most difficult to procure (to use a birdstuffer's term) "in the flesh," and for the purpose of representing thoroughly the Perthshire fauna, it is essential that as many species as possible should be forthcoming. The Zoological Committee, therefore, the more effectually to carry this out, have, in revising the list of the birds and mammals, indicated in the circular that stuffed specimens in good condition (that is to say not mothed) of any in the list, which have been got in the county, will be gladly received, either as a donation, or a deposit on loan for as long a period as the owner may think fit. Consequently he was glad to announce that several mounted specimens have been already received either on loan or as contributions. Some of these have proved especially rare, and, without this assistance, they could scarcely ever have been obtained; and, in the Society's name, he would here take the opportunity of expressing sincere thanks for the same. We must not forget either to add the thanks of the Society to all those who had so kindly contributed by sending birds "in the flesh." Among these stands conspicuous the name of Sir Robert Menzies, who has been most kind in the number of birds he has forwarded, as may be seen in the hawks and fine series of game birds in the cases upstairs. We can only hope that others may follow the good example set them by also tendering their aid to the Society, which aid is still much needed if the Museum is to be opened soon to the public, as is contemplated.

### REPORT OF THE EDITOR.

BY DR BUCHANAN WHITE, F.L.S.

The past year has not been distinguished by the publication, on the part of the Society, of any important work. The usual part of the "Proceedings" was issued in due course to the members, and that, with the addition of a list of the members and a catalogue of the Library, is all that the Society has sent to press. But if the year has not been marked by any unusual publication, it has unfortunately another claim to distinction in the annals of the Society. Rather more than a year ago, the Editor, in recording briefly the past history of the Society, and tracing the rise and progress of the magazine founded in 1871, remarked of the *Scottish Naturalist*:—"Like all magazines of a similar kind, its progress has not been one unattended with difficulty. Like them, the ranks both of its contributors and subscribers are not unlimited, and it may be that some day, from lack of one or the other, its career may be cut short. How many subscribers there may be to it in our Society I am unable to say, but I have little doubt but that there might be many more, and considering its origin and the low price, may say that there *ought* to be many more." Unfortunately, what was then suggested as a possibility has now become a probability, as the publishers (Messrs Blackwood & Sons) have decided to give up the magazine, though willing to enter into arrangements for its continued publication if the expenses are guaranteed. When the Society founded the magazine in 1871, it was thought to be rather a bold venture on the part of a young and undistinguished Society, and none of those who launched it anticipated for it a career of more than two or three years. Their anticipations were agreeably disappointed. From the time that the magazine was founded till that when, on account of the difficulties of publication by those not in the trade, it was made over to Messrs Blackwood in 1878, the *Scottish Naturalist* paid its own expenses, and there was a good demand for it not only in this country, but, in the way of exchange, also in Europe and America. But of late years several magazines of a similar nature have been founded, and have no doubt drawn to themselves some of the supporters of our magazine. Still, it must be confessed that, if they did not desire the cessation of the magazine, the members of this Society should have given to it much greater support than they did. That they failed to do so is not altogether very creditable to the Society. But if it has ceased to exist, the consolation remains that during the twelve years of its existence it has not been without some influence on the study of the Natural History of Scotland, and that many valuable papers appeared in its pages. To the editor the work of the past twelve years has been a labour of love. It has brought him many kind correspondents, and though at times the work was—as all who have been connected with a similar undertaking will understand—arduous, and sometimes thankless, he cannot regret the time and thought expended on the *Scottish Naturalist*.

On the motion of Sheriff BARCLAY, seconded by Lord Provost HEWAT, the reports were unanimously adopted.

### ELECTION OF COUNCIL FOR 1883–84.

The following members were unanimously elected as the Council for the session 1883–84:—

Colonel H. M. DRUMMOND HAY, C.M.Z.S., of Seggieden. *President.*

JOHN STEWART, Esq.
MAGNUS JACKSON, Esq., F.S.A.Sc.
D. M. SMYTHE, Esq., yr. of Methven.
S. T. ELLISON, Esq.
} *Vice-Presidents.*

JOHN YOUNG, Esq., C.E., Tay Street, *Secretary.*
JOHN MACGREGOR, Esq., Post Office, *Treasurer.*

Colonel H. M. Drummond Hay, C.M.Z.S., of Seggieden, *Curator.*
James Coates, Esq., *Librarian.*
F. Buchanan White, Esq., M.D., F.L.S., *Editor.*
P. D. Malloch, Esq. } *Councillors.*
John Campbell, Esq. }
A. Sturrock, Esq., Rattray. }

The thanks of the meeting were, on the motion of Bailie Gow, seconded by the Rev. Mr Young, awarded to the Executive for their labours during the past year.

The President then delivered his Annual Address, as follows:—

It being the established custom, at this particular meeting, for the President to give his annual address, I take this opportunity of now publicly acknowledging my thanks for the honour you have done me in again electing me as your President. Since I last had the honour of addressing you in that same position, in a far humbler building than the one we now occupy, nine years have elapsed; and during that interval much has been done for the advancement of the Society, and that, in a very great measure, owing to the untiring interest and energy displayed by both the very able Presidents who succeeded me, the late Sir Thomas Moncreiffe and Dr Geikie. In mentioning the name of the late Sir Thomas Moncreiffe, I need hardly repeat what is so well known to you all, that had it not been for his great exertions, in all probability we should never have been the possessors of the handsome and commodious building in which we are now assembled, and which is most appropriately associated with his name. It is not only in this respect that his memory is dear to us, but also from the recollections of the geniality and heartiness with which he invariably conducted all work in connection with the Society. Coming, therefore, in direct succession to the two gentlemen I have just named,—the latter, from his researches in geology, and great attainments in other scientific subjects, being particularly adapted for the duties of President of a Society such as this,— I cannot but feel somewhat diffident in having to follow so immediately in their footsteps; and I may say with confidence that the resignation of Dr Geikie, owing to his professional duties requiring his attendance elsewhere, will long be felt as a great loss to the Society; but, though not in office, still we trust we may often have the pleasure of seeing him among us.

But to proceed. From the reports we have just now heard, the Society may, I think, be congratulated on the general aspect of its affairs. The gradual increase of membership, and the desire which has been spontaneously expressed, in many cases from persons in the most distant parts of the county, for enrolment as members, is always a healthy sign, showing that our efforts are beginning to be appreciated throughout the county. Though young in years, and not yet out of its teens, the Society is continually in a state of progression, and every day becoming more developed. There is, however, plenty of room for greater growth, and when the advantages of the Society become more fully known, there will, I trust, be a still larger increase of members, not only from the Fair City, but from the county also. The advantages to which I have alluded, are, the free use of the Library, containing a valuable and well-chosen selection of books, together with many of the leading scientific magazines and papers of the day, writing materials, and other requisites; the laboratory, microscopic classes, &c.; and the Museum, where any spare time may be profitably spent. These, in addition to the monthly meetings and the summer excursions, may, I think, be considered a good equivalent for the trifling amount of annual subscription levied. For the benefit of those who are not aware of the fact, it may be as well to add that though the Museum is not yet in a sufficiently forward state to be thrown open to the public, the building is open to members daily, Sunday excepted, from the hours of 10 to 1 in the forenoon, and from 2 to 5 in the afternoon. I have brought this more prominently forward, as it must be remembered that the Society has an ever-increasing annual expenditure, and, as the admittance to the Museum is to be entirely free, this can only be met by a sufficiently large membership to carry it on.

Now that I am on the subject of the Museum, I may again say, to prevent any confusion, though it has been repeatedly stated before, that it embraces two distinct departments. The first of these is the Typical or Index Collection, the purpose of which is to shew concisely, and yet plainly, the scheme of classification, adopted by naturalists, of the animal, vegetable, and mineral kingdoms. This is at present contained in the upper portions of the four large table cases, and it is hoped that when completed, any visitor will, by a careful study of the specimens and their explanatory labels, be able to form a fair idea of the classification adopted and the relationships to each other of the various groups. Though well advanced, the Index Collection is not yet completed, but it is hoped that in the course of a few months, it will be in a state sufficiently perfect to fulfil the purpose for which it is intended. The other department of the Museum is the larger and more important; and, as it is restricted to illustrating the natural history of Perthshire, may be called the

Perthshire collection. So much has been written and said by naturalists of the highest authority regarding the importance of restricting local museums to the local products of the district, that it seems unnecessary to bring forward any arguments in defence of the scheme adopted by the Society. Having entirely in view the objects of making the Museum an instrument of education in natural science, and at the same time of doing something, be it ever so little, which will increase the sum total of human knowledge, the Society has followed the plan which seemed best adapted for carrying out these objects. For the purposes of this collection, the political boundaries of Perthshire are not at every point adhered to. To have done so, would have resulted in giving a false idea of the fauna, at least, of the district; therefore, the artificial boundaries have been overstepped in one or two directions, but the natural boundaries preserved. The chief overstepping has been in including in the district the whole of the River Tay down to its mouth, and not stopping at the very artificial boundary line of the county at Invergowrie. This applies very especially to the birds. At the same time, most of the specimens have been derived from Perthshire proper. This part of the Museum is intended to show to the visitor specimens of every kind of animal, plant, and mineral that is to be found in the district; and at the same time to convey, by means of comprehensive labels, as much information about each specimen as possible.

The present condition of the Perthshire Collection is as follows:—*Mammals* (or animals which suckle their young). The number of these in Perthshire is not large; including the seals and cetaceans, or small whales, which occasionally visit the tidal parts of the river, they do not amount to more than about 35 species. Of these not many have as yet been obtained; and without widely-extended aid, as has been already pointed out in my report as Curator, a great many will be most difficult to get; and it can only be by the kind assistance of those proprietors who have the objects of the Society at heart, that we can hope to possess such species as the red-deer, the roe-deer, and other animals, only to be found in the woods, preserves, and deer forests of the county. This applies also to many of the birds, especially of the larger birds of prey frequenting the same places; and as these last, together with such animals as the wild-cat, martin-cat, pole-cat, and even the badger, are all now most difficult to find in the county from the great persecution to which they have been subjected, I would most earnestly draw attention to the suggestions of the Zoological Committee, as already mentioned in the Curator's report, that where stuffed specimens of these exist, as they most undoubtedly do, in many parts of the county (often in a neglected and uncared-for state), should the owners not feel inclined to present them to the Museum, they may be induced to lend them on deposit for such time as they may feel disposed. Every care will be taken of them, and the Society would thus be given the means of more certainly and speedily carrying out its objects, as already stated, of rendering the Museum a means of education in natural science. Any addition, therefore, in this way, may, it is hoped, be made in good time to admit of the specimens being properly arranged and classified, previous to the opening of the Museum.

*Birds*. In collecting these, the Society, as reported, seems to have been more fortunate, and for the reason we have not far to go. Birds are more numerous, and certainly, to most people, more attractive than some of the smaller animals, or rather mammals; besides, being more generally brought to our notice in every-day life, they have become special favourites with all. Still much has to be done in this department also. Taking the basin of the Tay and its tributaries, from the source to the mouth, we have 150 species of regular occurrence, of which 86 are more or less resident, and 64 are of passage, the larger portion of the latter spending the summer for the purpose of rearing their young, the remainder passing the winter only with us. In addition, there are 41 which may be considered as only of occasional or accidental occurrence. This raises the list to 191 species, 125 of which are represented in the Society's collection. Of several of these there are two, three, or more specimens, illustrative of sex, age, seasonal changes, or otherwise. These are arranged with labels descriptive of habit, food, and locality, with date, and name of donor. In drawing up the printed lists of vertebrate animals of Perthshire and basin of the Tay, to be serviceable for labelling, it was thought advisable to include the names of such birds as in all probability will be found, when the fauna is more fully worked out, to visit the district, though their occurrence has not yet been sufficiently confirmed. This increases the number to 215, and with the view of showing at a glance the succession in which the several species come according to the classification, they will be numbered from 1 to 215, so as to point out any vacancy, or deficiency of a species, which will be at once indicated by the absence of the special number which belongs to it. To carry out this effectually, each specimen, besides having the individual number of the species, will be lettered from A onwards, in the order they have been received, and so entered in a catalogue book, ready at hand, so that any visitor may at once find out any particular specimen he may be in search of, or ascertain whether it be in the collection or not. It is further purposed to draw

up a catalogue, on the same principle, of all such birds as breed within the district, with a view of forming a complete collection of their nests and eggs. A small number of these have already been contributed, and though not yet systematically arranged, will shortly be so, each bearing a descriptive label telling the mode of nidification, such as the usual place of building, structure of nest, number of eggs and broods; and also, locality, date, and donor, with numbers corresponding to those in the catalogue. But to enable this to be thoroughly carried out, assistance in collecting the nests and eggs of the several species will be required from all those willing to lend a hand, to whom the desiderata will be made known. In the numbering of the specimens, it may be as well here to mention that the classification adopted is that which, resting chiefly on the character of the bones, is now pretty generally accepted by naturalists, and which system has been followed by Mr Dresser, in his late important work on "The Birds of Europe," in which he commences with the thrushes and concludes with the grebes, instead of beginning with the vultures and ending with the petrels, as in former works on ornithology. It cannot, however, be said that a universal system of classification has yet been secured, though perhaps a move in the right direction has been made, there being still some points of difference, in which ornithologists are not entirely agreed. Thus Mr Seebohm, in his new work on "The British Birds and their Eggs," in which he puts the birds of prey first, says that he does so as they were so placed by Cuvier in his classification,—"a system which," he remarks, "although it is now universally admitted to be mainly an artificial one, is so well known to all ornithologists that it may well serve as an index, until the natural order of sequence is discovered." I may here mention that it is in contemplation to have, in addition to the birds mounted in the larger cases in the museum, a full collection of skins, to be kept in drawers in the table cabinets, for the purpose of comparison, and more readily illustrating and studying the several genera. Of the 125 species which I have mentioned as being already in the collection, it may not be uninteresting to draw your attention for a few moments to some of the rarer and more valuable of these. First and foremost, then, I will take the King-Duck—a fine male specimen of which I was fortunate enough to procure through the services of Mr Henderson, of Dundee, it having been got last December on the Tay, below Dundee. The King-Duck, or King-Eider, as it is sometimes called, though generally considered a very rare bird in Great Britain—there being few British specimens in any collection—seems, of late years, not unfrequently to have been observed, during the winter months, off the mouth of the Tay and in the Bay of St Andrews. Mr Harvie Brown states that Mr J. Anderson, in a letter to him, mentions the King-Duck as plentiful in the beginning of January, 1879, about Dundee; and Mr Neilson told me he had killed a female of this species some few years ago, which, I believe, is the specimen now in the collection of the Dundee Naturalists' Society. This duck is not uncommon on the coast of Newfoundland, and abounds in the Arctic Seas, where it is frequently seen far out from land. Its powers of diving are said to exceed those of most other birds, as it can remain as long as nine minutes under water at a time, and reach a depth, in search of its food, of 100 fathoms. Another very rare bird is the Bittern. This bird was got some years ago in the neighbourhood of Blairgowrie, and is believed to have been shot in 1864. It was presented to the Society by Mr M. Gentle, and was—together with another, killed on the banks of the Tay, immediately below Mugdrum House, about the same time, and now preserved at Carpow—in all probability part of a large flight mentioned by Mr Gould as reaching our shores in the winter of 1863-4, when, as he states, examples were killed in every part of the country—from the northernmost part of Scotland to the extreme west of Cornwall. The Bittern, in former times, was by no means uncommon in Britain, previous to the draining of all the marshes and fens, and, probably, in those days, was often to be found in our immediate neighbourhood, in the Carse of Gowrie, when, no farther back than the middle of last century, it was, for the greater part, covered with reeds and swamps. Buffon's Skua, another rare bird, was shot on the Tay, off Newport, during the severe weather in December last. This bird, like the King-Duck, is also almost exclusively an Arctic species, not known, like some of the other Skuas, to breed in these islands, and appearing only in winter. Its food, except during the breeding time, when it feeds freely on the crowberry *(Empetrum nigrum)*, is procured, like others of its tribe, by plunder and robbery from Gulls and Terns. These it persecutes and buffets, until, in order to lighten themselves and fly the faster, they, to afford a means of escape, disgorge the produce of some successful fishing, which is adroitly seized before it reaches the water. This end being attained, the robber ceases his persecution, until the cravings of hunger prompt him to single out another victim. The autumn of 1879 will be long remembered by ornithologists for the remarkable arrival of Skuas, of several species, on all our eastern shores, when, during the months of October and November, they appeared in unaccountable numbers—more especially the Pomatorhine. Of these many were killed on the Tay. I have no record, however, of Buffon's Skua being in this

particular flight. Another rarity for the district is the Waxwing, or, as it is often called, the Bohemian Waxwing or Chatterer—one, out of a small flock of seven or eight birds, having been got at Seggieden, on the 29th of January of this present year. These were feeding on the berry of the holly, in company with the Redwing. So beautiful is this bird that Mr Gould describes it as one of the most singular and chastily-plumaged bird of the British Islands. *Apropos* to the attachment of "Bohemian" to the name of this bird, Mr Yarrell, in the second edition of his "British Birds," says it is not more common in Bohemia than it is in England. Though I have never heard it explained, I do not myself believe that the term ever had its origin in its being found in Bohemia, more than anywhere else, but that early authors so named it from the French term *bohemien*, as synonymous with gipsy, for which the country of Bohemia has ever been famous—a signification which would be well applied to the Waxwing, a wanderer, of no regular passage, appearing only at uncertain times and periods, no one exactly knowing whence. It was not till within the last few years, in 1856, that its native country was ever known with any certainty,—its breeding-place and mode of nidification being previously merely guessed at,—and it was entirely due to the unwearied researches of the late Mr John Wolley, in Lapland, in the year mentioned, that the discovery of the nests and breeding grounds put ornithologists for the first time in possession of full particulars respecting these points. The Great Grey Shrike, or Butcher Bird, though not so scarce as the last, is still far from being a common species in the county. Its occurrence, however, has from time to time been noticed, and scarcely a season passes but it shows itself somewhere in the district. A very fine female specimen of this species was sent from Murthly, having been shot in that locality for the Society's collection in March of last year. Mr J. G. Millais informs me that only very lately he saw another fine example of this bird in the same neighbourhood, sitting on a whin bush out in the open. In the neighbourhood of Geneva, where the Great Shrike used to be common, I have seen it for hours perched on the extremity of some decayed branch—a habit peculiar to this species, and from whence comes its specific name, excubitor: a sentinel. There it sits in erect attitude, with its white breast and light ash-coloured plumage shining in the full sun, like some bright speck against the darker foliage, and from thence it sallies forth in pursuit of beetles, or any thing which may happen to pass—be it mouse or small bird—which, when captured, it affixes to some thorn, or jambs into a fork of a branch, so as to enable it to tear the prey into small pieces. What remains is hung up and impaled, and left for another occasion—this slaughtering propensity obtaining for it the not inappropriate generic name of Lanius or butcher. It would take too long to dwell further on all the specimens deserving of remark. I will, therefore, merely mention the names of only a few others, which may be considered as the more valuable contributions, such as the Barnacle Goose, from the River Tay; Brent Goose, from Methven Loch; Canada Goose, from a loch at Fincastle (as this last is frequently kept in confinement, it is difficult to say whether it may have been truly wild, or a mere escape); the Pintail Duck, from the lower Tay; the Shoveller, from Methven, where it is now ascertained to breed; the Fulmar-Petrel, the Stormy Petrel, Little Auk, and Puffin—all four waifs from the sea, driven inland during the severe storms of late winters, and all got on the Tay, from the mouth as far up as opposite Scone, where one example of the Puffin was picked up in a dying state. In my concluding remarks on the birds I must not omit adding the Whimbrel and Grey-Plover—both rare, though pretty regular in their visits to the lower part of the district during the autumn and spring passages; and last, though not least, the Black-tailed Godwit. This specimen was presented by one of our own members, Mr Horace Skeete, and was shot by his father on the estate of Freeland as far back as the year 1810, and not having quite completed its winter plumage, it is probably an autumn bird. This fine example, which is in beautiful preservation, is of much interest, as being, so far as I am aware, the first recorded as shot in Perthshire, while its congener, the Bar-tailed Godwit, is by no means uncommon in the autumn and winter months on the lower Tay. The Black-tailed Godwit was once not uncommon in the fens of Lincolnshire, where it regularly bred. This the Bar-tailed does not do in this country, going further north. Possibly, now that the attention of the Society has been drawn to the working up of the ornithology of the county, the Black-tailed Godwit may prove not so rare to the district as has been supposed.

*Reptiles and Fish.* There are about thirty-two species of these—eight of the former and twenty-four of the latter. The reptiles being so few, it should not be long before these are all collected. To get the fish, on the other hand, will require much assistance from those in the position to give it. The salmon, in its various stages as to age and season, should be represented. Trout from various lochs and rivers are particularly in request—bull-trout, char, and grayling, &c. I may here mention that the carp and tench are, though included in the Perthshire list, not truly native, having,

in the places where they are now found, been introduced, or having escaped from some private pond. This we know to be the case in the instance of a carp and tench mentioned in the papers recently as having been caught in the Tay near the mouth of the Almond. These were escapes from the curling pond at Scone. The fish, on the pond being cleaned out last summer, were placed within a dam in the burn, which having been carried away by a spate, they all got off to the Tay.

*Insects.* In an inland district, such as Perthshire, insects form an important part of the fauna, not only because, as in all parts of the land surface of the globe, they are most numerously represented, but are more easily obtained for the purposes of study. At present one order only of insects is at all well represented in the Perthshire collection—namely, the Lepidoptera (or butterflies and moths). As specimens of these are easily injured by exposure to light, it is necessary to keep them in drawers, but these drawers are so contrived as to be open to the inspection of any one interested, without any special leave having to be asked of the custodian. In this respect we claim that our Museum affords facilities which most other museums do not possess, as in them the insects are kept locked up, and out of view. We have, at the same time, so managed that our specimens are secured against injury. At present the collection of Lepidoptera, though far from complete, is far enough advanced to give a good idea of what Perthshire can produce in this respect. As insects often vary, according to the locality, it is desirable that specimens of the same species, from various parts of the district, should be preserved in the Museum, and hence space has been kept for numerous specimens of each kind, and assistance from all who collect insects is requested to fill up the spaces in the proper manner. As in most other departments, common species, as well as rare, are asked for, but they must be Perthshire examples. Though none of the other orders of insects have been arranged, some specimens have been obtained, and any gifts of more will be thankfully received.

*Mollusca* (the Snail Family). From the geographical position of Perthshire we are necessarily restricted in a great measure to the land and fresh water species of Mollusca. We already possess most of these, and they have been arranged; but as it is desirable to have them represented by specimens from various parts of the county, donations will always be acceptable.

*Other Invertebrates* (or Animals without a Backbone). These are either not many, or else they are so difficult to preserve and exhibit that little as yet has been done among them. It is to be hoped that more attention will eventually be directed to them, though they have not been entirely neglected.

*The Vegetable Kingdom.* Perthshire, from its varied surface, is very rich in plants, and as most of them are of easy preservation, they can be well shown in a museum. To begin with the larger specimens—the native trees of Perthshire—the true natives, excluding those that have been introduced by the agency of man, are not very numerous, and it is intended to illustrate these by specimens of the wood. To do this properly, three specimens are necessary—one to show the bark, the other the wood longitudinally, and the third in cross section. In addition, each will be illustrated by characteristic photographs of the tree itself. The native trees are oak, ash, elm, birch, aspen, willow, holly, alder, hawthorn, and Scots fir. Of these we have already, birch, aspen, and Scots fir represented by good specimens; and if any one will send us a good thick trunk, about three or four feet long, of native specimens of any of the others, we shall be much obliged. Of the flowering plants and ferns we have already got an almost complete collection, so far as specimens of nearly all the species to be found in Perthshire go; but as it is very desirable there should be specimens of each kind from many localities, for the purpose of illustrating the local effects of soil, position, elevation, &c., the herbarium may be increased almost indefinitely. As it is, we have already many thousand specimens, and most of these are arranged in their proper places. As for the lower plants (mosses, lichens, fungi), specimens are being accumulated, but, as yet, there has been no time to arrange them, which, however, will be done as soon as possible.

*Geology.* In this department we are not quite so advanced as we could wish, still a good beginning had been made, and, by the kind assistance offered by Professor Geikie, we may hope in time to have it very complete. But to do this we must at the same time set to work ourselves, and all members interested in the study of geology, it is to be hoped, will give a helping hand. This may be done, in one way, by getting the lessees of quarries, in their own neighbourhood, to help, by sending specimens a few inches square, of the various forms of stones in their several quarries; and others might help by sending specimens of any remarkable rock or boulder in their own vicinity, or a selection of stones from any good section of till or boulder clay, with a note of the locality, position, &c. In conclusion, for I fear I have taken up your time too long already, I would only add a few words, as I wish strongly to impress upon the members of the Society the impossibility of getting up a complete Perthshire collection in all its branches, without help from every quarter; and I have no hesitation

in asking for this help, as the collection is not for the aggrandisement of the Society, but for the benefit of the whole community of Perthshire. Should this help be given, as I sincerely trust it will, the Museum may, I hope, be ready for throwing open to the public early this autumn, and, as I have said before, free of all charge. (Applause.) The working bees, however, are comparatively few; the sooner, therefore, that things are sent in, the sooner will the Museum be ready. All specimens forwarded, either as gifts, or lent on deposit, should be addressed directly to the Perthshire Natural History Museum, Tay Street, Perth.

On the motion of Mr ATHOL MACGREGOR, East Wood, Dunkeld, seconded by Rev. Mr TAIT, St Madoes, a hearty vote of thanks was given to Colonel Drummond-Hay for his excellent address.

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April 12th, 1883.

MAGNUS JACKSON, Esq., Vice-President, in the Chair.

DONATIONS.

The following donations were announced:—Goosander (male) in full plumage; also, four ptarmigan in autumn plumage from Rannoch (skins in very fine condition)—from Athole Macgregor, Esq., Eastwood, Dunkeld; badger (mounted specimen)—from Charles Murray, Esq. of Taymount, Stanley; rook and rook's nest with eggs, and wood pigeons (male and female)—from Colonel Drummond-Hay of Seggieden; stoat (a very fine specimen)—from Mrs Struan Robertson, Croiscraig, Rannoch; glass rope sponge (*Hyalonema Sieboldii*)—from Dr Lilburn.

EXHIBITS.

Dr White, on behalf of Dr Lilburn, exhibited specimens of the Glass Rope Sponge (*Hyalonema Sieboldii*).

NEW MEMBERS.

The following were elected:—Mr Samuel Walker, Sharp's Institution; and Mr John Sinton, teacher, Cherrybank.

The following were nominated for election at next meeting:—Mr Andrew Heiton, architect; Rev. David Macfarlane; Dr Ferguson; Mrs Struan Robertson; Mr Peter Wilson, 73 Leonard Street; Mr John Carnochan, manager, Perth Cemeteries; and Miss Forbes, Athole Street.

THE EDITORSHIP.

It appeared from the minutes of a meeting of Council that Dr Buchanan White had resigned the office of editor, and that it had been agreed to leave the duties in the hands of the Council at present.

"THE SCOTTISH NATURALIST."

It also appeared from the minutes that the Council had agreed to discontinue the *Scottish Naturalist*, on the ground that the "Proceedings" were to be extended, and would, therefore, take its place in the meantime.

The following paper was read:—

"*The Cultivation of Fruit on Waste Lands and Pleasure Grounds.*" By Dr Robertson, Errol.

I have no doubt many members of this Society will wonder why I have chosen such a subject for a paper as "The Cultivation of Fruit on Waste Lands and Pleasure Grounds," seeing there are so many famous arboriculturists amongst us, and some even whose daily business it is to work among trees of all kinds; whereas I am but a very humble amateur in the pursuit. My reason for choosing such a subject, being an amateur, is, that it has been a pleasant pastime to me—one which has given me a very great deal of pleasure and some little profit—and that being so, I feel anxious to enlist others in the same agreeable pursuit, feeling perfectly assured that if it gives them but half the pleasure it has afforded me, they will be amply repaid.

If, in preparing this paper, I have unconsciously trespassed on any one formerly read at any meeting, you will kindly pardon me, as it is my misfortune to have been at very few of the regular meetings on account of having to attend meetings of other Societies more immediately connected with my profession.

Since the time our grandfather Adam was placed in Eden to keep it and dress it, many a noble mind, many a diligent hand, and many a happy hour have been pleasantly and profitably employed in cultivating the various kinds of fruit which a kind Providence has made to grow on this fair earth, which might be made much fairer still if only half the time that is idly spent at street-corners, and in beer-shops, and in a thousand and one other places, where neither true pleasure nor profit is obtained, were spent in the cultivation of fruit. I long to see the time when our horny-handed artizan, our palefaced clerk, our young men from behind the counter, as well as our teeming millions from the mills, by the aid of cheap morning and evening trains, will be able to live in

tidy cottages in the country, with nice gardens surrounding them. Instead of living in unhealthy towns and cities, drinking bad water (such as they say you have in Perth), bad beer, and burning whisky, and sleeping in miserable garrets — breathing carbonic acid gas, and perhaps a still more unhealthy moral atmosphere—how much better would it be to bave nice little cottages and gardens in the country, where, after the day's work is over, tbe leisure hours could be pleasantly and profitably spent in the cultivation of fruit. How much bealthier mentally, morally, and physically would our rising population be were they trained in such homes in the country, and how soon, with willing hands, migbt many a waste piece of ground be made to rejoice and blossom as the rose. But some, no doubt, will say to me—"Oh! tbere is scarcely any waste land in this country, especially near our large cities and towns, where such homes as you describe could be got for the working classes." I reply that plenty of it could be got even on tbe fertile braes of the Carse of Gowrie, which is not half-cultivated as it should be. If such be the case in the far-famed "Garden of Scotland," as it is sometimes called, I am sure it is so with most other places throughout tbe lengtb and breadth of the land. Wbat a vast amount of fruit could be grown along tbe Braes of the Carse, between Perth and Dundee—and even in the glens or dens as they are called—where, at present, is to be found mostly whin and broom, or, perhaps, at best, a patcb of grass. Take as an example, Pitrodie Den, so well known to botanists. This would be an excellent exposure for growing apples, pears, plums, and cherries on the richer soil of the slopes; and where the soil is lighter strawberries could be grown in abundance. Here let me tell you that there is money to be got from tbe cultivation of strawberries. Just a few days ago, I asked a gentleman, who has been engaged the most of bis lifetime in the cultivation of fruit, what was the largest sum he ever obtained for strawberries from a given piece of ground. The answer was—"From 11 falls of ground, planted with strawberries, I got £12 10s." Raspberries, gooseberries, and currants could be grown wiih great advantage in Pitrodie Den. The same migbt be done in the neigbbouring Den of Kilspindie; and, indeed, all along tbe braeface, where at present very little is grown. In order to prove what I say, let me carry you in imagination to the little village of Rait, situated in a den also. Visit that hamlet in spring, and see the tidy gardens filled witb fruit trees and bushes of all sorts, and see the lovely bloom of the apple and pear trees. Visit it again in autumn, and see the ripe, luscious fruits in all their varied bues—from the little golden pippin with its tinted cheek, to the rosy "Fair Maid of France"—and I am sure you will be pleased with the prospect. But let us pass on a few hundred yards farther south to the famous garden and grounds of Annat, and there you will see the golden-gage plum growing to advantage, where it was first reared by tbe famous botanist, the late Mr Gorrie. After examining tbe other fine fruits of tbis famous spot, I can fancy you chanting the lines of the old song—

> Oh! for a cottage near a wood,
> Where health and plenty still prevail.

Let me take you a little farther along tbe Braes of the Carse, to the famous seat of tbe late Sir P. M. Threipland of Fingask. I will not take you to the gardens, as at present I am anxious to show you bow comparatively waste lands may be utilised. I will take you to the orchard, also in a den. In the month of May, when the trees are in bloom, to get upon an eminence and look down upon the vast expanse of white and purple blossom, fills one witb rapturous delight. But suppose it is autumn when you visit it, you will see the branches bending to the ground with fruit of all sizes, tints, and colours, while cartload after cartload is being sent off to market. After seeing this you will say there is a vast amount both of pleasure and profit to be derived from the cultivation of fruit. In this orchard there are some very famous trees, from which twenty to thirty hampers of fruit are taken in one season. An old orchard-keeper lately told me that one year a Dundee fruit-mercbant paid £11 for the fruit of one tree in this orchard—an Irish Green. It covers an area of about 60 yards in circumference. One season's fruit from a tree like this is more than the value of a forest-tree altogether after growing for more than a century. Let us now hurriedly pass ou to the famous Den of Kiunaird, where stands the famous old Castle, with its antiquarian relics. Here there are some fine old trees, but many more could be grown, and would add considerably to the beauty of the scenery, more especially in front of the Castle. But time flies, so I must hurry you on along the braes; but let us have a passing glance of the nice little mansion of Ballindean, which is so snugly set at the hill-foot, that it looks like a robin's nest in an ivy wall. In this orchard I have seen fruit as fine and as abundant as anywhere in tbe Carse, thanks to the intelligent and industrious gardener, Mr Reid, who is a most energetic arboriculturist. Pass on witb me now to the famous Dens of Balruddery, the property of Mr J. F. White. The mansion-house stands between two beautiful dens, with a burn running through each of them. At the present time the dens are rather thinly covered

with trees, many of the older ones having been taken out lately; but in former times I have seen them perfectly clad with fruit trees, besides being filled with small fruit of various kinds—such as raspberries, currants, gooseberries, and strawberries, — a splendid example of economising space, and just what I would like to see in many more of the Carse orchards. At the present time some of the proprietors and tenants, who have no small fruit, suffer considerably when the large fruit fails—as in the case of recent years—whereas had they grown, as they might have done, small fruit in the inter-spaces, it would have been much to their advantage. But, perhaps, some will tell me, as I have been told before, that small fruit cannot be grown successfully among trees. Let me say at once, in all plainness, that this is a fallacy, and, at the risk of being called an egotist, I will endeavour to give you proof of this. In my own garden I have my trees growing as thickly as in any orchard in the Carse, and yet for a good many years I have been able to take prizes at the Dundee Horticultural Show for gooseberries, and red, white, and black currants. I have shown gooseberries larger than any I have seen at the Dundee Show, and these grown within a yard of large fruit trees. I sometimes wish I had the space between the trees where some of our proprietors have nothing but wild grass. For example, in an orchard of about 30 acres, what a vast amount of small fruit could be grown: black currants in the strong damp clay soil; raspberries also in damp, shady situations; and gooseberries and currants in the drier parts. With gooseberries from 1½d to 3d per lb., and blackberries from 3d to 9d, you will agree that there is money derived from them. I know a garden in Errol, of about an acre in extent, filled with large old fruit trees, and yet I have known in one year of £50 having been obtained for one sort of gooseberry ("Red Warrington") grown under these trees. I think I have now shown that a considerable amount of fruit can be grown on comparatively waste lands; but let me give you another example I heard of a few days ago. On the little estate of Flatfield is a piece of ground, nearly half-an-acre in extent, near the high road, and almost completely shaded with the large forest trees on the neighbouring estate of Megginch, with which it marches. You might almost call it a bog, for it really is so for a great part of the year, and yet the late proprietor, Mr Bruce, thought he would try to grow on it a few apple and pear trees, with gooseberries and red and black currants in the interspaces. All the labour it got was very little indeed, some years only a rough turnover with the graip or spade, and sometimes not even that. Yet here is the result as given me by his widow, Mrs Bruce:—The first year, 15s; the second, 30s; the third, £7; the fourth, £9; the fifth, £8; the sixth, £13 10s; the seventh, £9; and the eighth, £17 10s. I leave you to judge of the results for yourselves. When I look around me, I sometimes think the ground is not nearly cultivated to the extent that it might be. All along the riverside, and on the brae face, where there is nothing but a few forest trees and stunted shrubs and wild bramble—cover only for game to eat the farmer's crops—what a vast amount of fruit could be grown. No less an authority than the late eminent arboriculturist, Mr Matthew of Gourdiehill, said—"If I had the sea braes on the riverside I would keep a dozen of men constantly employed in fruit cultivation, and yet make it pay;" and he knew well the value of fruit. In one year, from Gourdiehill orchards, which are about 30 acres in extent, £1400 was obtained; and this only included apples and pears, with a very few plums. Now, after deducting £200 for working expenses, this left a handsome margin to the grower.

Sometimes, when I am advocating this fruit theory in private, I am told that the seasons are so changed now that we cannot cultivate fruit successfully, and cope with foreign importation. So far as the seasons are concerned, I must admit that they have been bad enough of late, but you may as well tell the farmer not to sow his fields on account of bad seasons and foreign competition, as tell the orchardist to give up cultivating his trees. I have no doubt that warm seasons will come again, as they did before. I have a book, written nearly two hundred years ago, on the cultivation of fruit, and I quote a sentence from it to show that sometimes they had a run of bad seasons then as well as now:—"Thirdly, That some seasons of late years have proved very bad, and may have spoiled the fruits, though the greatest care and skill have been used about them that was possible." Now, no one will deny that we have had good summers since then, and we will have them again. So far as foreign competition is concerned, I grant that America can beat us in some kinds of apples; but with a return of fair seasons, I think we might hold our own in the market. Quite lately I asked a grower, who has been engaged half a lifetime in the fruit trade, what was the greatest quantity he ever took from a single tree. The answer was:—"I once took 30 hampers of large pears from one tree in Seaside Orchard, growing near the Mansion-House." Another orchard-keeper told me he took 23 hampers from the same tree. Another orchard-keeper told me she took a ton of Irish green apples from one tree in the Horn Orchard. Now, a hamper of pears weighs from 80 to 100 lbs.; and apples

from 80 lb. to 90 lb. In ordinary seasons, from average-sized trees, 2 to 5 hampers is a common crop. Even at a ½d per lb., this would pay well, and in a great measure prevent foreign competition, as it would not pay to import at this low figure ; and were orchards attended to as they might and should be, they would pay still better. I have been through most of the orchards in the Carse, and in the great majority of them there is very little attention paid to pruning and manuring. Some even go the length of saying that orchards do not require manuring. Now, let me give an example to the contrary. Some three years ago, I think, we had a fair amount of fruit blossom, but, on account of the previous summer being a comparatively sunless one, the wood was not well ripened, and the fruit buds were consequently weak, and when the spring frosts came they almost all dropped off for want of strength to set the fruit. A small orchard at the Grange of Errol had just been leased by a new tenant and the ground manured and ploughed, with the following result. The manuring gave the weak fruit buds a spurt, and enabled them to set fruit, as it is termed, and when I went through it in the autumn (it is about 8 acres in extent) I saw more fruit in it than in all the other Carse orchards put together. But least it may be thought that I am mistaken in my conclusions, let me give another example. In another orchard, under a different tenant, with only the public road between them, about a third part was manured and ploughed up, while the remainder was left in grass, with the result that the part manured had a fair average crop, while the part left untouched had only a very small sprinkling of fruit. This is surely proof of the benefit to be obtained from good cultivation.

I now pass on to the next part of my subject, viz., "The Cultivation of Fruit in Pleasure Grounds." How it is that fruit trees in this country are so rigidly excluded from the lawns and pleasure grounds of our landed proprietors, is more than I can understand. I cannot conceive of anything that would more conduce to the beautifying of pleasure grounds than the cultivation of fruit trees. With their variously-coloured blossoms in spring, and their heavily-fruited branches of every shade and hue in autumn, they could not fail to be ornamental. Fruit trees could be planted in almost every conceivable way in pleasure grounds, to suit the taste of the cultivator ; in squares, lines, or curves, on arches or espaliers, or standards, or dwarfs, or mixed with laurels or forest trees. On the Continent it is quite common to have them mixed with forest trees, as will be seen from the following extract from the *Garden* of 21st Feby., 1880:

I (says J. Cornhill) consider that fruit trees have some claim to be considered ornamental. In Germany, where flowering trees and shrubs are held in higher estimation, and are more extensively planted, than in this country, the line between the fruit and pleasure ground is not so closely drawn as in England. There are often seen fruit trees intermixed with ordinary trees and shrubs, and I consider that this form of arrangement has much to recommend it. In the first place, the rather cheerless aspect which shrubberies so often present during the early months of the year is much relieved thereby; and then, again, trees thus placed often yield a portion of fruit, when those in more exposed situations have been chilled by cutting winds or sharp frosts. I have frequently remarked that an apple or pear tree, which by chance has found a place in the shrubbery, has produced fruit when those plantations most relied on have, owing to the inclemency of the season, completely failed. There are probably few more beautiful floral objects than an orchard in full bloom, and few flowering trees or shrubs can rival the apple or pear, with their showy blossoms. When so planted that they are in the vicinity of evergreens, especially such as are distinguished by the sombre hue of their foliage, the effect is very beautiful. I have had the good fortune to reside in some of the finest fruit-producing districts in Europe, and have often thought that nothing could exceed in peaceful beauty the aspect of the Rheinthal and Necker valley during the flowering season of the fruit trees. I have a vivid recollection of once standing upon an eminence in the vicinity of the Vosges mountains from whence seventeen villages could be counted, each one embowered in fruit trees, and lying snugly in valleys surrounded by hills clothed with lines of sombre hue,—the whole forming a scene worthy of the most gifted painter's brush. The valley is also extremely beautiful during the month of May, studded with little hamlets, nestling in the shelter of the hills, and surrounded with fruit trees of fine proportions, thus forming a series of delightful floral pictures of which the eye never seems to weary. In the palace garden of Leidwigsburg there are whole avenues of fruit trees, which, so far from appearing misplaced, rather seemed to add to the attraction of the place. It is certain there are many situations in gardens in this country, such as the wild garden, the shrubbery, or the half-annexed portion of the pleasure ground, where a few fruit trees might be introduced with pleasure and profit to the owner. There are, of course, some varieties which, by their vigour and manner of growth, are better fitted than others for the purpose and only such should be planted.

Another writer in the *Garden*, "J. G.," under the heading "Fruit Trees as Ornaments," says :—

It is singular how persistently we cling to old notions, one of which is that the useful and ornamental are rarely combined, and that when it is so the useful character of a tree, shrub, or plant is sufficient to prevent it from being employed in an ornamental way. We are all acquainted with the beauty of fruit trees, which is quite equal, if not superior, to that of many ornamental trees grown wholly for their flowers. Yet how seldom do we find a fruit tree in our pleasure grounds, large or

small, except behind a hedge or screen to shut it out of sight? Are we so much enslaved by prejudice or fashion as to blindly follow an absurd practice,—one that makes half the country barren, when, by utilising fruit trees in both their useful and ornamental characters, we might increase our supplies of fruit threefold from the space now occupied by totally unproductive subjects. Fruit trees in spring—peaches and nectarines, with their cheery blossoms, and cherries, plums, apples, and pears—form such sheets of bloom as to be quite striking; and when covered with fruit, I find them highly appreciated for purposes of decoration. Why, then, do we forbid their presence on lawns and in pleasure grounds? We talk of Kent as the garden of England; more than half its beauty is due to fruit trees being planted indiscriminately, that the eye always catches the beautiful effect which they produce according to the season of flowers or fruit.

Hitherto I have been speaking of pleasure grounds on a more extensive scale. Let us for a few minutes see what could be done with smaller ones—say, nice little lawns attached to our ordinary gardens. What could be nicer than a row of well-kept pyramidal apple and pear trees around a lawn, or one here and there planted through the lawn, as I have seen them. Some varieties, such as Lord Suffield, Stirling Castle, and the Emperor Alexander, are very showy indeed. Beautiful roses they are, either in the half-open bud or full bloom — roses which might even please the eye of a Reynolds Hole; and then how ornamental in autumn to see such large fruit as Lord Suffield, Stirling Castle, Lord Dunmore, Philip's Seedling, and a host of others which could be named. The trees I have mentioned can be grown in as little space as an ordinary gooseberry bush. They can also be grown in little tubs or pots, and placed round the edges of walks, or in other empty spaces, for the time being. Only last year I had one in a little empty butter tub, not larger than a three- or four-year-old gooseberry bush, with about two dozen of splendid apples on it, six of which enabled me at the Dundee Autumn Show to take the first prize in the Amateur Class for table apples; while the rest helped me in taking the second prize for five varieties of hardy fruit. I merely mention this as an encouragement to others to engage in the same pleasant pursuit. I could have said a great deal more on the subject had time permitted. I might have mentioned some of the old-fashioned small varieties I would cut out of our orchards and gardens, and the kinds I would substitute for them, or graft where I cut down; for let me here state that there is no need for digging up a healthy tree although the kind is not good. Another kind has merely to be grafted on it, and a large new tree will be formed in three or four years. I think a great deal can be done in the way of improving fruit by grafting our finer and more delicate kinds, on hardy and free-growing stocks. To make clear my meaning on this subject, let me give an example. Most of our fruitgrowers know well how fine yet how delicate a pear "Louise Bonne of Jersey" is, and that in our climate it will only grow to perfection on a wall or under glass. It scarcely ever succeeds as a standard. A few years ago, an amateur friend of mine got some grafts of it, and by chance put them on a "Craig's Favourite," —a very healthy and free-growing kind, — and with the very best results. Two years ago, we had a very sunless summer, and although fruit was plentiful, it was neither large nor well flavoured; yet this friend's grafts were loaded with large, beautifully-shaped pears, weighing nearly a pound each, and without a bad spot. This shows the benefit of grafting the more delicate kinds on robust stocks. I might also have said a good deal about the various kinds of crab apples, which, I am happy to learn, are becoming fashionable in our more aristocratic pleasure-grounds for purposes of decoration; but if time and opportunity occur, I may return to the subject on some future occasion. It is said that "the man who makes two blades of grass to grow where only one grew before, is the benefactor of his country." If I have succeeded in convincing any one to try to grow fruit where none grew before, my end will be gained.

In reply to questions, Dr Robertson said that birds were sometimes very hurtful to fruit, especially the bullfinch. The cause of the blossom falling off trees was the want of nourishment, which might be prevented by spreading manure pretty thickly round the roots, and also giving them a good supply of liquid manure. Peaches did not grow well in this country owing to the coldness of the climate, but with a good southern exposure, he had seen them successfully reared. He had seen them grow very well in Megginch gardens. A 16- or 18-inch flower-pot was quite capable of growing a tree which would yield about two dozen of apples.

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24th April, 1883.

A Microscopical Exhibition was held within the Lecture-Room this evening, which was open to the general public, and was very largely attended. Twelve microscopes were

arranged on tables running across the room, and also on the platform. These included the instruments belonging to the Society, besides a number which were kindly lent by members; and they varied in power from ¼ to 2 inches. The objects exhibited represented a wide range of microscopical research, and included many specimens of great interest. The different sections were under the charge of the following gentlemen:—*Entomology*, Mr Magnus Jackson, Perth; and Mr Marshall, Stanley. *Physiology and Pathology*, Mr James Stewart, Perth. *Botany*, Messrs James and Henry Coates, Perth. *Infusoria*, Messrs Robertson and Wood, Blairgowrie. *Rotifera*, Mr Wood, Blairgowrie. *Chemistry*, Mr Keith, Perth. *Geology*, Mr Mackay, Perth. Astronomical photographs taken from nature were exhibited by Mr D. M'Lagan, Perth, and Chromo-lithographs of several of the slides shown were exhibited by Mr R. D. Pullar, Perth. The changes of colour in chemical crystals and in sections of crystaline rocks were exhibited by the aid of the polariscope. The circulation of the blood in a frog's foot, and also the sap circulation in plants *(cyclosis)*, were shown to great advantage. The Museum was also open to the inspection of the public, and was largely taken advantage of. The whole arrangements, which were of the most complete description, were under the charge of Mr John Campbell, optician, High Street.

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## May 3rd, 1883.

Hugh Barclay, Esq., LL.D., in the Chair.

### NEW MEMBERS.

The following were elected :—Dr Ferguson; Rev. David Macfarlane; Mrs Struan Robertson; Mr P. Wilson, Leonard Street; Mr Carnochan, Superintendent, Perth Cemeteries; Mr A. Heiton, architect; Miss Forbes, Athole Street.

The following were nominated for election at next meeting :—Miss Burton, Marshall Place; Mr J. S. Imrie; Mr H. H. Greig; Mr P. Strang, jun., chemist; Mrs Roy, Craigclowan; Mr Alex. Murray; and Mr A. H. Lumsden, Superintendent of Fisheries.

### DONATIONS.

The following donations were intimated:—Coot—Mr J. Pearson, gamekeeper, Methven Castle; carp—Mr Speedie, St John Street; coot, dabchick, and amhurst pheasant—Mr D. M. Smythe, yr. of Methven; sparrow-hawk—Mr Young, Freeland; owl—Mr W. Campbell, Blair-Athole; peregrin falcon—Mr Stewart, Logiealmond; 14 gull's eggs—Mr Scott, Methven Castle; pair bullfinches—Mr W. Campbell, Blair-Athole; dipper's nest and eggs—Mr P. D. Malloch, Perth.

The following paper was read :—

"*Mimicry in Insects.*" By Mr S. T. Ellison.

The term "mimicry" has been adopted by naturalists, in place of any other more applicable, to denote those cases which are to be found throughout the animal world where advantages accrue to certain animals on account of their colours, either resembling other animals which have for various reasons immunity from danger, and thus the former share in the advantages possessed by the latter; or else they derive benefit by their colours harmonizing with their surroundings. Some have restricted the application of the term to those only which imitate other animals; but in asking your attention to-day for a short time to the consideration of a few cases of mimicry in insects, I shall make use of the term in its widest sense, including within its range all the various aids to protection—whether of form, of colour, or of action, either singly or combined—by which insects are enabled to hold their own against and overcome the many dangers to which they are exposed, believing that it is as much mimicry when an insect, by its form, resembles a twig, or when an insect, by its action, feigns death, as it is in the case of those insects which, by their colours, imitate other insects of widely-separated orders. The principal objection to the term is that, at first sight, one might suppose that the animal possessing the advantages referred to resorted to and used them cousciously for its protection—a definition I do not think any one would agree to accept. Of course, in those cases where the actions of insects aid or add to their protective appearance, I think we must admit a certain amount of instinctive consciousness,—cases of which I shall mention further on. The prominent position attained by these mimetic resemblances in so many cases is no doubt owing to the selection and continuance of those forms which have afforded the most perfect freedom from danger, aud by the eradication of those which have preseuted points of weakness.

The dangers to which insects are exposed may be included under two heads—first, danger of perishing from lack of food; and, secondly, danger from being made food of by

other animals. These dangers, proceeding from extreme sources, form the key-note, so to speak, of our subject, bringing about a fight for life which extends to all animals in a state of nature, and supplying us with the immediate cause, some of the effects of which are to be seen in the cases I shall bring under your notice. But at the outset, and as introductory to our subject, allow me to refer to the competition for life to which all animate nature is exposed.

The power of competition is not only experienced by the lower animals, but man himself comes under its sway. It was competition, and the difficulty of obtaining food for their ever-increasing numbers, that led barbarous nations to resort to the horrible practice of infanticide; so that, by the reduction of their numbers, the struggle for life might not be so keenly felt by those remaining. It is competition which, to a large extent, regulates the accumulation and distribution of wealth; and it is competition which has effected the onward progress of civilization, culminating in the wonderful advances of scientific and commercial pursuits during the present century. Among animals, too, as we have previously noticed, it is the most important agent in maintaining equally poised the balance of Nature. When we consider, on the one hand, the rate of increase of which many insects are capable, and, on the other, the number which annually perish—often, I suppose, being as many as are annually born—we can form pretty clear ideas of how keen the struggle must be. The productiveness or fertility of insects is often enormous. Many leave eggs to be numbered by the hundred, some by the thousand. Others leave larger numbers. The common house-fly, for instance, often leaves a progeny of 20,000. Among aphides, however, we have perhaps the most remarkable fecundity of any. We all know by experience how rapidly the green fly multiplies on our rose trees and geraniums. Réaumer calculates that one aphis may be the mother of the enormous number of 5,904,900,000 individuals during the month or six weeks of her existence, and Professor Huxley has made the curious calculation that, assuming an aphis to weigh as little as the one-thousandth part of a grain, and that it requires a man to be very stout to weigh more than 2,000,000 grains, he shews that the tenth brood of aphides alone, without adding the products of all the generations which precede the tenth, if all the members survive the perils to which they are exposed, would contain more ponderable substance than 500,000,000 of stout men—that is, more than the whole population of China. As, however, it is impossible for us to grasp such vast numbers, let us take a similar case, though one a little more easy of appreciation. Suppose a butterfly, or moth, leave the very moderate number of 10 eggs, which, in due time, develope into 5 pairs of insects. Now, if we assume that these increase at the same rate, and that the conditions surrounding them are perfectly favourable, so that none perish, we shall find that the tenth generation, as the progeny of this one insect, will number nearly 20,000,000 individuals. When we consider figures such as these, we can see what disastrous results would follow were insects allowed to multiply, even at such a low rate of increase as I have just referred to, without any checks. However, we find that, just as a large proportion of the seeds of the vegetable kingdom are not allowed to continue their kind, but serve as food for many animals, so vast numbers of insects are preyed upon by other predatory insects and by birds.

We are thus led briefly to notice the close connection and dependence of one animal upon another for its subsistence. Thus, one insect in a district, may be the cause of the presence there of some predacious insect: this, again, causes the presence of insectivorous birds. We see how birds follow in the wake of insects, though not with reference to any district, in the case of the swallow. It has become proverbial of fine weather when the swallows fly high, and as an omen of foul when their flight is low. But why is it that the swallow flies high or low? Not because it recognises the rarety or density of the atmosphere. No; but for the simple reason that the insects upon which they feed, and which they therefore follow so closely, are regulated in their flight by the conditions of the air. We find, then, that to keep some insects from too rapid increase, predatory insects, or some opposing agents, are necessary to hold them in check. These, again, need some restriction, else they too might increase, so as to overcome, and perhaps exterminate, the former ones, and thus, owing to our imperfect knowledge of, and our inability to follow, the interchangeableness and intricacy of the laws regulating the distribution of species, and the intimate connection existing throughout the whole organic world, we become quite confused, and cannot see our way amid such a labyrinth. Mr Darwin, for instance, tells us that the fertilisation of the Dutch clover depends on the cat. You will wonder how he arrives at such a conclusion, but his line of reasoning runs thus: the humble bee is the only insect which fertilises this clover; field mice destroy the nests and combs of the humble bee; and they in their turn are destroyed by cats. Thus the abundance or otherwise of this clover in a district may be materially affected by the number of cats. A later writer, in seeking to go a step further back, rather dryly suggests that this useful animal again, in its turn, may owe its abundance to the number of unmarried ladies of mature

years residiug in the neighbourhood. When an insect possesses any protection sufficient to meet the dangers to which it is exposed, we find no other is exerted in that direction; and whenever bright colours are not dangerous to an insect, they are often profusely given.

With this digression, I now come to the subject we have mmediately in hand. Everyone is aware that bees and wasps are often of bright and gay colours, but they have a wonderful protection in their stings, and on that account receive all due respect from their neighbours. But although these formidable tribes are so strongly armed, they too have their enemies in the shape of some parasitic flies of the genus *Volucella*. These have no stings or offensive weapons of any kind with which to wage war against their stinging hosts. Their modes of operation are of a more subtle nature, for they mimic so closely, by their colours and general appearance, the bees and wasps upon which they prey, that they can enter the nest unmolested, as members of the community, and, having gained admittance, deposit their eggs in the larvæ, thus sowing the seeds of destruction in the nest, and also fulfilling their mission of providing for their progeny, by placing them in circumstances necessary to their development. You will find some specimens of the genus *Volucella* in the Museum, and can see how easily they would be mistaken for humble bees. We are told that "a man's enemies are often those of his own house." This is, I think, very true of humble bees, taken altogether as an order, for there are parasitic humble bees which closely resemble in appearance other humble bees in whose nests they are reared. Among sawflies we find that many, on the approach of danger, mimic or feign death. Tucking their antennæ, legs, and wings close to their bodies, they fall to the ground until the danger is gone. As insects pass through various stages before attaining their perfect form, they are exposed to, and therefore require protection from, danger during every period; and so the principal means of defence of the sawflies, while in the larval state, consists in the power to eject liquids, or the discharge of obnoxious odours. The liquids are often of an acid nature, and can be thrown to considerable distances. The larvæ of one species (*Perga Lewesii*) discharge a gummy matter, the use of which is often clearly shown when an ichneumon, which preys upon this species, is found in the secretion, having its legs and wings firmly gummed together. In most cases where secretions or fetid odours are discharged the larvæ are of bright colours and gregarious in their habits, several feeding on the same leaf. Among the orthopterous order the same phenomena are to be observed. Anyone who has tried to find a grasshopper among the grass or low herbage knows what a protection its colouring affords it, but when we examine the genera *Mantidæ* and *Phasmidæ*, or the leaf and stick insects and spectres, the imitation existing between these insects and the vegetable world becomes truly alarming. Their legs are made to resemble leaf-stalks, the body being elongated and notched so as to imitate a twig, and the large wings are exact imitations in colour and neuration of a full-blown leaf. There is a specimen of *phasma* in the British Museum which, perhaps, eclipses even these, for the wings are covered with spots and blotches, giving it the appearance of vegetation marred by the ravages of insects. You will see a specimen of the stick insect in the Museum. Mr Belt, in his most interesting book, *The Naturalist in Nicaragua*, gives a most curious case where a species of the green leaf-like locust (and here, I think, we have a case of reason or conscious instinct) added to its protective colouring by its action. It was suddenly surrounded by a large number of the insect-eating ants. From this dilemma it could easily have escaped by taking to flight, but would then most likely have been pounced upon by the insectivorous birds which usually follow the ants; and, seeming instinctively to know this, it just remained stationary among the insect host, trusting to its protective appearance, which happily did not fail it, and the ants, many of which passed over its body, pursued their journey, unconscious that they had been so near a good meal, or had been so easily deceived. The aphides, to whose remarkable power of multiplication I have referred, happily have many enemies. I shall mention two that are rather remarkable, which prey upon them—namely, the larvæ of *Chrysopa* and *Hemerobius*, belonging to the order *Neuroptera*. These, after extracting the nutritive moisture of the aphides, have the most curious habit of arraying themselves in the skins of their victims, piling one on after another until they are partially concealed. Whether they derive any advantage from this practice I have not seen stated, but I am inclined to think they must do so by being able the more easily to approach and seize their prey. Many beetles receive freedom from attack on account of their elytra or wing-cases being very hard; others, again, have the power to emit obnoxious odours. The pretty and brightly-coloured Ladybirds (*Coccinellidæ*) discharge a fluid of a very disagreeable nature, and it is probably on this account that they are never eaten by birds. The Dung Chafer Beetles, on the approach of danger, feign death, and it is said that they thereby deceive the rooks, as these birds will only eat them when alive. The ever-famous Bombadier Beetles strike terror among their enemies by the sound which they can make, as of an explosion, accom-

panied by the ejection of a fluid which, on contact with the air, immediately volatizes, and appears like a puff of smoke, from which they derive their military title.

In coming to the Lepidopterous order, or the butterflies and moths, I shall consider them rather more minutely than I have done the other orders. On looking at some of our common butterflies, one might suppose at first sight that they would be exposed to great danger on account of their very gay and conspicuous colours; but I shall endeavour to shew, and I trust to your satisfaction, that such is not the case. We must remember that the time of danger to these beautiful insects is not so much when they are engaged in flight as when they are at repose. Now, from the position they assume when at rest, —which is with their wings erect, having the upper surfaces folded together,—they expose only the under surfaces of their wings. The Admiral (*Vanessa Atalanta*), the Peacock (*V. Io*), the Tortoiseshell (*V. Urticæ*), and the Blues, are all good examples of this. The little and brightly-coloured copper (*Polyommatus Phlœas*) is so similar when at rest to the withered ferns and grass on which it delights to rest, that it is almost impossible to see it. The Grayling (*Satyrus semele*) defies detection by the similarity of the colouring of the under-side to the face of the rock on which it rests; and although you can see one fly to a certain spot, it is very difficult to find it until it again takes wing. The Green Hairstreak (*Thecla rubi*) is another which as soon as it settles on anything green is entirely lost to sight. These cases, I think, clearly indicate the uses of the sombre and mimetic appearances of the under-sides of the wings.

Turning our attention now to the moths, we shall find the same remarks as to the bright colouring to hold good here also, namely, that when at rest the brightness is usually hidden from view, but we find a material difference in the part where it is located owing to the different position of the wings when at rest. Most moths do not keep their wings up like the butterflies, but fold them flat over their bodies,—the fore wings overlapping and hiding the hind wings, so that only the upper surfaces of the front wings are exposed to view. On examining these moths we shall find that almost all that have bright colours have them placed on the hind wings, and the front wings are usually of dull or quiet tints. You will see this in the Eyed Hawk (*Smerinthus ocellatus*), the Tigers (*Callimorpha dominula*, *Chelonia caja*, and *C. villica*), the Red and Yellow Underwings, &c. The Rev. Joseph Greene has pointed out the striking harmony that exists between the colours of the British moths on the wing during autumn and winter and the prevailing tints of Nature at those seasons. In autumn various shades of yellow and brown prevail, and he states that out of 52 species that fly at that season no less than 42 are of corresponding colours. In winter, grey and silvery tints prevail, and the moths, at this season, are of harmonious hues; and no doubt from this general harmony with the aspect of Nature at the times when they respectively appear these moths receive many advantages. Stones, stone walls, and the trunks of trees—especially those covered with lichens—are favourite resorts for many moths to rest upon, and these moths are often so similar in their colouration to their surroundings that detection is very difficult. Such, for example, as *Bryophila perla*, *Acronycta psi*, *Larentia cæsiata*, *Boarmia repandata*, and many of the geometræ. The Buff Tip (*Pygæra bucephala*), from its position and the markings of its wings, looks just like a broken lichen-covered branch. The Lappet Moth (*Lasiocampa Quercifolia*), too, might easily be mistaken for a bundle of withered leaves. One family of moths seems to have discarded the scaly wings peculiar to their order, and to have assumed clear wings, resembling bees, hornets, ichneumons, &c., and seems to receive immunity of attack from imitating their stinging neighbours. Among moths, too, there are many species in which the female is wingless, or at all events the wings are in a very rudimentary condition,—whether through disuse or not, it does not concern us now,—but I think they thereby receive advantages which they could not possibly have were they winged like their partners. As most of them are what I may call winter visitors, I think their wingless condition is evidently one of protection. The moth Winter Beauty (*Phigalia Pilosaria*) emerges from the pupa state about January. The male being of a silvery tint, and similar to the trees on which it is found, receives good protection from its colours; —the female, however, being wingless, is much more protected, and is very rarely to be met with in Nature, as it can get between the crevices of the bark, and so be entirely out of sight. These remarks also apply to other wingless moths, such as *Cheimatobia brumata*, *Hybernia rupicapraria*, *H. Progemmaria*, &c. In the pupa state, too, moths need and receive protection. Many bury themselves in the ground, and are thus out of the sight and reach of their enemies. Others, again, form their cocoons on the trunks of trees, mimicking the bark so closely that detection is almost out of the question. Of these, I may mention the Puss (*Dicranura Vinula*) and the Kitten (*D. Furcula*), and also the remarkable pupæ cases of the family *Psychidæ*. Others, again, make their cocoons of tough materials. Of these the Fox (*Bombyx Rubi*) is an example. The cocoon of the Emperor (*Saturnia Carpini*) is well deserving mention. It

is very tough, and the larva, before pupation, leaves a hole at the one end for the exit of the moth, but so arranged, on the old mouse-trap principle, that it is quite easy for the moth to come out, but impossible for anything to enter from without. Perhaps it is, however, while in the larval state that insects are most open to danger, being then either a delicate morsel for birds, or else a nice and well-stored home where some parasitic fly may put its family out to board. A large number of larvæ are green, corresponding to the leaves on which they feed. Others, again, are brown, imitating the bark or twigs of the trees on which they rest. These, by their colours, and many of the geometræ or loopers, aided also by the forms they assume, sticking themselves out rigidly on their annal prolegs from a stem or branch, are easily overlooked. I remember the first larva of *Amphidasys Betularia* I ever had I got in rather a strange way. I was feeding some larvæ of the Peeble Prominent *(Notodonta Dromedarius)*, and on giving them a branch of birch every day, I always examined very carefully the old food which I took out, for fear any larvæ should be attached to the stems. One day, on removing the old food, I was much struck at seeing what I thought at first was a very remarkable growth,—a thick stem coming from one of smaller size,—but on taking hold of it to examine it more closely, I was very much surprised on feeling a soft larva curl up between my fingers. It must thus have been attached to the branch when I cut it from the tree. Many observations and experiments have been made on larvæ with birds, frogs, &c., the evidence of which I may state as briefly as possible. All larvæ, such as I have just mentioned, which imitate in colour the leaves and stems of trees, are greedily eaten by birds. Spiny larvæ, such as those of the Tortoiseshell and Admiral Butterflies, and also hairy larvæ, such as those of the Tiger (*Chelonia Caja*), &c., are all rejected by birds; so that their spines and hairs are a protection to them. The colours of some larvæ are bright and conspicuous, and these do not feed singly and on the undersides of leaves, &c., like those which mimic vegetation, but are usually gregarious in their habits, and seem by their very actions to court observation, such as *Abraxas grossulariata*, *Diloba Cœruleocephala*, *Euchelia Jacobeæ*, &c. These, at first, presented a difficulty not easy of explanation, but the experiments above referred to seem to have revealed the true use of their conspicuous colours. Larvæ of these species were given to birds at various times,—sometimes mixed with others which were greedily eaten,—but these bright ones were always rejected and left to crawl away, shewing that they must have been distasteful to the birds; and it has been suggested that in these cases their colours serve them good purpose, acting as danger-signals or warnings to birds that these are not edible. The only other instance of protective colouring among larvæ I shall mention is that of the Emperor Moth (*Saturnia carpini*). The larva, in its earliest stages, resembles very closely the stems of the heather on which it feeds, and is also at this period covered over with a very fine down. Later on, when the heather presents a greener aspect, and the larva has changed several skins, we find it also robed in green, with a black band across each segment. When the heather is in full bloom, and the larva is nearly full grown, it becomes spotted with bright pink, and so by its assimilation to the surrounding heather it evades much danger. Among the cases of protection afforded to insects by their actions, I would mention how many beetles and spiders, when danger is at hand, roll themselves up and feign death, and, when the danger has disappeared, quickly find their feet and make off. Many moths adopt the same course, the most remarkable of which that has come under my own notice being the Coxcomb Prominent (*Notodonta camelina*). Finding one morning a specimen on the top of the breeding-box, in which the cocoons were situated, I put my hand in, and, at the same time giving a sharp knock with the other hand on the outside, dislodged it from the top, when it fell into the palm of my hand. On examination it appeared quite lifeless, and I thought it must have been out for several days, and had died. I turned it over several times, and then threw it up a little, letting it fall as heavily as possible, but still no signs of life appeared. To make sure, I tried if its legs were rigid, and, on applying my forceps to one of the feet, it gave a kick—the first evidence of life I had observed. I replaced it in the box, lying on its side, and, after being left for a time in quietness, it soon righted itself.

Of tropical insects I can only mention one or two. One of the most wonderful is certainly the Leaf Butterfly of India (*Kallima inachis*), described by Mr Wallace. It is a large and beautiful insect, the ground colour being deep bluish, and having a broad band of orange across the wings. Its flight is quick, and when on the wing it is very conspicuous, but it has only to settle on a branch to be entirely lost to view, for the undersides, by their colours and the shape and position of the wings, give it the exact appearance of a leaf. Mr Wallace states that it seems to have the instinct to rest among dead and decaying leaves, so that this combination of colour, form, marking, habit, and instinct produce a degree of concealment which is perfectly startling. The Heliconidæ of tropical America is a group

of butterflies which are very abundant. Owing to their possessing a powerful odour, which is peculiar to the caterpillar, chrysalis and perfect insect, if a specimen be crushed between the fingers, a yellow fluid oozes out, having a strong pungent smell, which stains the skin, and on account of which no birds will eat these insects. Many species in this order are imitated, but I will only mention one, *Mc'hone Psidii*, which is mimicked in size, colour, and markings by *Leptalis Orise*, belonging to a different order altogether,– viz., the *Pieridæ*, or the order to which our common whites belong. In all cases where one species mimics another, the two always inhabit the same district, and the mimicking species is always very much less abundant than those it imitates. "In proportion," says Mr Wallace, "they are often not one to a hundred, and sometimes not one to a thousand." The Duke of Argyll, writing from Cannes uuder date of 9th November, gives another very remarkable instance of mimicry in the case of a moth which settled on the ground in front of where the Duke was sitting, and which was then a very conspicuous object, but on becoming alarmed, by turning slightly round and giving a violent jerk to the wings, it immediately became iuvisible, as it then imitated the withered and crumpled leaves by which it was surrounded. "Here, again," the Duke adds, "was one of those cases of mimicry in which the completeness of the deception necessitated the co-operation of the insect's own will." (See *Nature* of 7th December last.)

The subject we have considered to-day is one of great extent, but I venture to think that the cases I have brought under your notice will have been sufficient to convince you that the forms and the actions of insects have not been given to them without serving a useful purpose, and that their colours have not beeu scattered in any careless or haphazard fashion, but that all serve them good purpose, either affording them protection from danger, or helping them to procure the necessaries of life ; and that they also play a wonderful part in helping to keep that harmony of Nature in which all are so much interested.

The lecture was illustrated by several drawings and specimens of butterflies and moths.

On the motion of the Rev. Dr MILROY, seconded by Mr JOHN MACGREGOR, a cordial vote of thanks was awarded Mr Ellison for his valuable paper.

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## SUMMER SESSION, 1883.

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The following Excursions were made :—

24th MAY.

1. *Banks of the Tay below Errol.*

As in the physiography of Perthshire the River Tay is a very important feature, it has been the custom of the Perthshire Society of Natural Science to dedicate, if possible, one or more of its excursions each year to an exploration of some part or other of the banks of the river. As is well known, these present very different aspects, accordingly as they are near or are remote from the mouth of the river, and it can be well imagined that the fauna and flora is equally various. Of course, certain plants and animals occur throughout the course of the Tay, but many are confined to particular parts, and even the individuals representing species that are to be found from the source to the mouth of the river are not unfrequently characterised by local peculiarities arising from the differences of soil, climate, &c., that the different parts of the banks possess. For example, the individuals of a common plant which, in the middle parts of the course of the river, does not present any special peculiarities, often take on in the upper parts of the course a more dwarf habit and larger and brighter coloured flowers; while nearer the estuary the leaves are sometimes apt to become more fleshy. Such variations may seem to be of little moment, but, when regarded in the light of the evolution theory, they become interesting, and as the Society is always desirous of iuculcating on its members the importance of studying in the field the facts brought before them in the lecture-room, excursions to various parts of the river banks will always afford material for investigation and discussion.

The first excursion for the season took place on Thursday, when the banks of the estuary from Longforgan to uear Port-Allau were visited and examined. Perthshire having no seaboard proper it is only in the lower parts of the river that any approach to a maritime or marine flora and fauna can be found, and that, moreover, rather restricted in its nature.

The excursion was conducted by Dr Robertson, of Errol, who, it will be remembered, read an interesting and

instructive paper on "The utilization of waste grounds for the cultivation of fruit," to the Society last winter. This paper we will have occasion to refer to presently. The walk along the shore from Longforgan to Port-Allan is a very pleasant one, and thougb no specimens of special rarity were met with, yet the varied character of the banks of the fore-shore, of the river itself, and of the Fifeshire hills, added to the delightful weather with which the party were favoured, made the excursion a very enjoyahle one. Soon after reaching the shore at Longforgan a patch of peat was discovered lying in the marshy ground beside the river. An examination of tbis, and the occurrence in it of the remains of heetles and of various plants, showed that it was part of the huried forest hed that underlies the clay, and stretches from Perth all over the Carse of Gowrie. Good sections of this bed were ohserved near the mouth of the Earn during the first excursion made hy the Society last season, and will he found described in last year's "Proceedings." Though this peat hed was not again seen in any of the clay hanks examined during the day, yet a hit of Scots-fir bark was found in the clay at about a depth of 12 feet, some miles further up the river. Another interesting geological find was that of a bed of cockle *(Cardium)* and other marine shells in the clay. It is well known that in the brick clay at Errol are heds of Arctic shells, but these cockles are in an apparently much younger clay, and present a very different aspect. An account of their geological history, bowever, must be reserved in the meantime. Amongst the more notahle plants ohserved were various maritime species, the rarest of which (in Perthshire) is *Sagina maritima*, which had not hefore heen noticed higber up the estuary than Kingoodie. A more interesting plant is the fungus *Æcidium rubellum*, parasitic on leaves of dock, on which it forms brilliant crimson patcbes, dotted with the white star-shaped cups of the mature fungus. Apart from the beauty of the plant it is of great interest as being one of the fungi in which the curious phenomenon of heterœcism has heen proved. This means that not only is the fungus parasitic on two entirely different kinds of plants, but that on these it assumes sucb a very different form that till recently they were supposed to be two kinds of fungi having no relation to each other. It must not he supposed, however, that the two forms of the fungus occur indifferently on one or other of the host plants. On the contrary, they form in their life history a cycle or alternation of generations. For example, the one just mentioned, that forms the cups on dock-leaves, produces its spores or seeds, which, however do not reproduce tbe same form of fungus, but, being blown by the wind on to the leaves of tbe common reed, germinate there and produce quite a different looking fungus, which occurs in the form of dark brown powdery patches, the pseudospores (or false spores) of a *Puccinia.* These in their turn germinate and produce other spores, which find their way to the dock leaves and produce the above-mentioned *Æcidium.* This phenomenon is now known to occur in a numher of fungi and in some there are even more than two stages in the cycle. A knowledge of this fact is not of botanical interest merely, hut of great importance to agriculturists, for the well-known and frequently-destructive "rust" which attacks wheat, is tbe stage of a fungus which requires the harherry for another of its stages, and consequently it has heen proved that where harberry bushes are growing in the neighbourhood of wheat fields, the wheat is liahle to he much attacked by "rust," and a cure has been effected (or rather the attack prevented) by destroying the harherry hushes. After finding the *Æcidium rubellum* on the dock leaves a search was made amongst the reeds, which are so conspicuous a feature on the foreshore of the river, for the *Puccinia* stage of the fungus, and specimens of it were found on the dead stems. It was not to be expected that it would be found in a fresb condition, as it is in autumn that this stage occurs, and wbat were found were merely the dried remains of last year's production. Another fungus of interest that turned up is one *(Synchitrium taraxaci)* that is parasitic on the dandelion, and the chief interest attaching to it is that it had not apparently been previously grown in Scotland. Amongst higber plants one must be specially noticed. This is tbe lady's smock or cuckoo hud (*Cardamine pratensis*), a plant common enough in damp meadows, but seldom seen in sucb profusion as in one small meadow near the river, where its pale purple flowers perfectly carpeted the ground. On examining some of the plants a curious (hut not unknown) malformation was found, in whicb tbe flower is quite perfect except the pistil. This, or rather the part of it known as the ovary, which contains the young seeds, is so altered that the ovules or young seeds have retrograded into petals. The blossom when it first opens is apparently normal, hut in the course of a day or two the stalk of the pistil lengthens, and a second or double flower is produced inside of the first.

Passing over several other interesting "finds," as well as the adventures of tbe party in crossing several "pows" deep with slimy mud, it will be sufficient to say that in due time Errol was reached, when Mrs Robertson very hospitahly gave the excursionists tea, which, after the heat of the day, was as welcome as it was unexpected. As great a treat followed in the form of an inspection of Dr Rohertson's garden, wbich

fully bore out the statements he had made in his paper.

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JUNE 30th.

3. *To Methven.*

To the student of Scottish botany the name of Methven Bog is, or ought to be, very familiar. It is here that the plant with the rather uncouth name of *Scheuchzeria palustris* is alone found in Scotland. We say "rather uncouth name," but as it commemorates the services to science of two Swiss botanists, the name is after all not unpleasing to the ear of a naturalist. But though Methven Bog is thus botanically famous, it is to the dwellers in its neighbourhood altogether unknown! This does not arise because, as might be supposed, it is not considered worthy of a name, but because it has another name than that which botanists have bestowed upon it. Its local name is "White Myre," or "Bingie Loch." The former of these we may suppose to have been bestowed upon it by reason of the abundance of cotton grass—the poetically famous "Down of Canna"—which at one time adorned its surface. How the name "Methven Bog" arose, we imagine was in this wise:—When the plant was first recorded as a native of Scotland, the locality was given as "a bog near Methven." In course of time this became abbreviated into "Methven Bog," and this name it has retained—for botanists—to the present day. From this it will be gathered that it was to no unexplored spot that the Perthshire Society of Natural Science made its second excursion for this season. The excursion was conducted by Capt. Smythe, yr. of Methven, a Vice-President of the Society. Starting from Almondbank Station, Methven Bog (we adhere to the botanical name) was first visited. Since the days when this marsh became botanically famous, its physical conditions have been much altered, chiefly through the damming up of the ditch which to a certain extent drained it. The damming up has resulted in a large increase in the quantity of water, and a consequent alteration in the flora. Several of the more interesting plants have, it is to be feared, altogether disappeared, and amongst them is perhaps the above-mentioned *Scheuchzeria*. As, however, there is no direct proof of this, it may yet be included in the list of the plants of Perthshire.

The first interesting plant noticed was the Water Hemlock *(Cicuta virosa)*, a large and very poisonous plant with small white flowers. This is one of the few localities—if not the only one—where this plant grows in Perthshire, and hence we were glad to observe that not only is it increasing in quantity, but that it has spread into another marsh at some distance from the original situation. Amongst other plants gathered may be mentioned the cranberry *(Vaccinium oxycoccos)*, which here grows in large clumps,—an unusual habit in this part of Scotland,—the rather rare sedge *Carex irrigua*, *Pyrola minor*, *Veronica scutellata*, and other commoner plants.

In connection with Methven Bog must be noticed the large colony of black-headed gulls which now inhabit it. These are several thousands in number, and form a sight worth seeing. On this occasion they had the honour of being photographed by a member of the Society, though it cannot be said that they showed their appreciation of the honour by remaining quiet to have their portraits taken.

Passing on by another marsh, in which no remarkable finds were made, the party made their way to the neighbourhood of Methven Castle, and spent some time in inspecting some of the more remarkable trees which adorn the shrubberies. Apart from their intrinsic merits, some of the trees here are noteworthy for other reasons. The late Mr Thomas Bishop, who was for fifty years land-steward at Methven, and whose name is associated with the discovery of several rare plants in Methven Wood, left behind him a manuscript book (now in the possession of Mr Smythe), in which are recorded, not only the history of some of the trees, but the measurements of their girths taken at intervals of a few years. This record has been continued down to the present time, and thus there is in existence interesting notes on individual trees extending over a period of more than 80 years. Among the more remarkable trees that may be mentioned is the Pepperwell Oak, with a short bole of immense girth. Mr Bishop remarks of this tree that it belongs to the variety or species to which the name *Quercus pedunculata* has been given, but that it partakes in some respects of the characters of the variety or species *Quercus sessiliflora*. We had not an opportunity of examining the fruit, in the form of whose stalks the chief distinction lies, but from the nature of the leaves we are inclined to think that it may be placed under *Quercus intermedia* of D. Don. The three forms are considered by botanists to be only varieties of *Quercus robur*.

After duly admiring some beautiful specimens of various coniferous trees, and making a hurried inspection of the gardens, Methven Wood was reached. Part at least of this has been woodland from time immemorial, and hence contains many features of interest to the naturalist. The native trees include oak, alder, hazel, birch, aspen, &c.,

and perhaps Scots fir, and under their shade grows a profusion of wild flowers. Of the latter the most conspicuous on the present occasion were the bugles, whose bright blue blossoms were in great profusion. A reddish purple variety was also found. Among other plants noticed were several kinds of orchids, including the curious bird's-nest orchid, the twayblade, butterfly orchid, marsh orchid, and broad-leaved helleborine. Some others are reported to grow in this wood, but were not seen on this occasion. In addition to these, the herb Paris, the *Veronica montana*, and other somewhat local plants, were noticed. A plant of some antiquarian as well as botanical interest is the Lily of the Valley (*Convallaria majalis*), which is indigenous in this wood, and is mentioned as occurring here in Sibbald's "Scotia Illustrata," a work which was published more than 200 years ago. Another plant is interesting from growing in an unusual locality, namely, the Club Moss, *Lycopodium clavatum*, which is usually an inhabitant of heathery moors, but which here grows under the shade of the trees. After spending a considerable time in the wood, a visit was paid to Methven Loch, whose margins were brilliant with the golden flowers of the Iris or Water-flag, while part of its surface was studded with the smaller blossoms of the rare *Nuphar pumila*, one of the yellow water-lilies. At the Loch the excursion terminated, and the members of the Society took their way homewards, much pleased with the day's ramble.

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AUGUST 4th.

4. *To Loch Ordie.*

IN glancing over the map of Perthshire with a view to selecting places for excursions, the Council of the Society had more than once taken into consideration the desirability of organizing an excursion to Loch Ordie, but up till the present season it remained in the list of places "to be explored." Deep in the bosom of the hills to the north of Dunkeld, Loch Ordie is surrounded on all sides by the immense larch woods with which the enterprise of several successive Dukes of Athole has clothed the barren moorlands. Long famous for its trout, it was thought possible that the loch might also possess something of interest for the zoologist or botanist, and that whether or no it came up to the expectations of the explorers, yet, on the principle of "*omne ignotum pro magnifico*," it was highly desirable that it should be investigated. On application to the Duchess-Dowager of Athole for permission to visit the loch, Her Grace not only at once gave permission, but very kindly provided the party with carriages and boats. The excursion was conducted by Mr John M'Gregor, the Duke's head-forester, and a member of the Society, and to him, as well as to Mr Macintosh, the headkeeper, and Mr Maclaren, the land-steward, the party was much indebted for the manner in which Her Grace's instructions were carried out, and for otherwise promoting the success of the investigation. Saturday last was the selected day, when those members who were able to join the excursion proceeded to Dunkeld, whence they drove by the private road to the loch. The drive, as all who have had the good fortune to take it know, is very enjoyable; but as the chief object was the exploration of Loch Ordie itself, we will in the meantime pass over the details of what was observed on the road, reserving these for the return journey. On arriving at the loch the party divided into three sets—two electing to explore the loch, while the third ascended a neighbouring hill. In this way a good idea of the productions of the locality was gained. Those in the boats proceeded to row slowly round the margins of the loch, using the various curious implements which experience has shown to be necessary for an exploration of this nature. The results of this part of the investigation may be briefly recorded as follows:—

Loch Ordie lies in a rock basin excavated out of the Gneissose Silurian rocks during the glacial period. The shores are mostly rocky, occasionally forming low precipices, and at these points the depth of the loch is very great even close to the shore. At other points it is less deep near the shore, and in such places most of the "finds" were made. The bottom is generally stony and rough, and consequently possesses but little vegetation. In a few places it is muddy, and here plants are more abundant. The chief water-plants noticed included the quill-wort (*Isoetes lacustris*), very abundant and fine, and the pill-wort (*Pilularia globulifera*), much scarcer and rather poor. Both these plants are allied to the ferns, and possess a very curious structure. Of the pond weeds or *Potamogetons* (of which the lower-lying lochs between Dunkeld and Blairgowrie possess so many species) three only were found, viz., *P. perfoliatus*, *P. natans*, and *P. rufescens*. The other vegetation included the water-lobelia (*L. Dortmanni*), with pale blue flowers; *Litorella*

*lacustris*, and *Juncus supinus*—the latter being a rush which grows both in damp places, where it produces flowers, and in comparatively deep water, where it never flowers. Another plant which was found in sparing quantity was a moss, *Fontinalis antipyretica.* Of animals very few species were seen, but those that came under observation were carefully noted, as it was desirable to ascertain, if possible, to what food the trout of the loch owed their rich quality. It is stated that the Loch Leven trout feed upon a minute species of crustacean (which may be broadly stated to be a kind of fresh-water shrimp), and it seems probable that the Loch Ordie trout have a similar food, as a similar crustacean was noticed on Saturday to occur in vast numbers on the leaves of the pond weed, *Potamogeton perfoliatus*, on which they seem to deposit their eggs. The name of the animal has not yet been determined, but it is possible that it is not confined to this special weed. At the same time if it is proved that it is a favourite food of the trout (and this may be ascertained by dissecting a few fish), it may be advisable to encourage the growth of the *Potamogeton*, which, as far as could be seen, was not as abundant as it might have been. Of fresh-water shells, which in some lochs are reputed to be a favourite food of trout, only a single specimen was noticed, viz., a small example of *Physa fontinalis.* On the whole, the loch did not produce so much as it was expected, though, as will have been perceived, it was not without its points of interest.

The hill party reported nothing of any special interest, though the members were rewarded for their climb by a magnificent view. After the investigation of the loch was completed, it was decided to visit some marshes that had attracted attention during the drive up. Before setting out to do this, however, one of the party brought in a very extraordinary malformation of the common foxglove, in which not only several of the flowers were united to form one gigantic blossom, but this blossom contained in its heart another blossom. The specimen had, in addition, several other points of interest. On the way to the marsh just alluded to, the Dowally Lochs were passed, and a short time spent in examining them. The most noticeable features about these little lochans is the great quantity of the water-lobelia which adorn the margins. This plant, which inhabits lakes in mountain districts, has a rosette of leaves at the bottom of the water, from which rosette arises a brownish-red leafless stem bearing the pale blue flowers above the water. Another plant noticed was the small flowered form of the white water-lily. This form is the native one in the Highlands; and it seems somewhat doubtful whether the large flowered southern form has not been planted in all the localities where it occurs in Perthshire. The marsh on being examined turned out to be disappointingly unproductive, and when the carriages came up the party returned to Dunkeld, having, even if they did not get all they expected, enjoyed a very pleasant day.

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SEPTEMBER 1st.

5. *To Kincardine Glen.*

MOST travellers by rail between Perth and Stirling must be familiar with the picturesque ravine crossed by the line near Auchterarder, and known as Kincardine Glen, but probably very few of the multitudes who have thus cast admiring glances into it have ever had an opportunity of exploring its beauties. By the kind permission of Mr Johnstone of Kincardine Castle, the Perthshire Society of Natural Science arranged an exploration of the Glen on Saturday last, and found no reason to regret the selection of that place for the last excursion of the season. Proceeding to Auchterarder Station, a short walk (under the guidance of Mr Martin, of Aberuthven, the conductor of the excursion), landed the party in the Glen, but not before a rather rare, though only a naturalised plant, had been found, the spotted dead-nettle *(Lamium maculatum)*, a pretty plant with purplish flowers and nettle-shaped leaves of a bright green, spotted with crimson and marked by a snow-white longitudinal blotch. Curiously enough, later in the day another form of the same plant was found, but with white flowers and the leaves without the crimson spots. The plant is not a native but an escape from old gardens. The Glen was found to be even more picturesque than the view from the railway indicated. Through it the little River Ruthven meanders, its banks sometimes thickly wooded, sometimes only dotted with trees or bushes, or opening into meadow-like glades. The sides of the Glen are very steep, and even, in some places, rocky, and adorned with a thick clothing of mixed wood. Here and there a tributary burn rushes down the sides making on the way many pretty little waterfalls. From the appearance of the Glen the hope that it would be found prolific in local plants was excited, and though, from the time of year, as well as the hurry with which the ground had to be gone over, doubtless many things escaped notice, it was found that appearances did not deceive. Amongst

other finds the following may be mentioned :—*Veronica montana*, *Vicia sylvatica*, *Rubus saxatilis*, *Chrysosplenium alternifolium*, *Circæa lutetiana*, and other plants which, though like these, cannot be called rare, yet indicate that the locality is a good one. Another plant—the green spleenwort (*Asplenium viride*) is decidedly rare in this part of Perthshire, but used to occur abundantly in one spot in Kincardine Glen. Unfortunately the rapacity of fern-hunters has nearly eradicated it, but a careful search showed that it may still be reckoned as part of the flora of the Glen. In addition to plants Kincardine Glen is probably rich in other departments of natural history, but requires exploration. A rather rare land shell (*Helix fusca*) was noticed, as well as some local insects.

Leaving Kincardine Glen the party took its way by roads and across fields to the Heugh of Coul. On the way thither some rather interesting plants were observed. Among these perhaps the rarest, so far as Perthshire is concerned, is the sticky groundsel (*Senecio viscosus*), a plant not unlike the common groundsel, but covered with hoary and viscid hairs. A large patch of this was seen on the railway bank, its usual situation in this part of the country, and indicative of its introduction with the ballast of which the banks are built up. A little further on another plant (the goat's beard, *Tragopogon pratensis*), not uncommon in the Carse of Gowrie, but rare in other parts of the county, was found, but, like the above-mentioned groundsel, has been probably introduced in this locality. A third rather local plant was the field camomile (*Anthemis arvensis*). By the kind permission of Mr Smeaton of Coul, the Heugh of Coul was next explored. "Heugh" means a glen with steep overhanging sides, and the Heugh of Coul may be taken as a very excellent illustration of the term. The sides are in many places precipitous, and in almost all very steep, and, at the bottom, the burn, by whose long-continued action the ravine has been formed in the trap rocks, pursues its varying course, now dashing over ledges, now resting in deep black pools or flowing between walls of rock. Notwithstanding their steepness the sides of the Heugh are well clothed with trees, bushes, and humbler vegetation, even the perpendicular rocks having in many places a rich coating of mosses which revel in the damp shade. With considerable skill footpaths have been carried up and down the Heugh at various levels, by which easy access can be obtained to many parts of it; others are, however, quite inaccessible. As in the case of Kincardine Glen, no doubt a longer search at a more favourable time of the year would reveal the existence of a number of interesting plants in this place. The rarest that was found is perhaps the sedge *Carex muricata*, which is a very local plant in Perthshire. It was found both in the Heugh and on the hillside above it. Other interesting plants were the shining-leaved geranium (*G. lucidum*), with its pretty pink flowers; the wood sanicle (*Sanicula Europæa*), *Melica uniflora*, *Crepis paludosa*, &c. Amongst trees the elm is common, and probably indigenous. After leaving the Heugh, the way back to Auchterarder was taken, and a few additions were made to the list before the station was reached. Amongst these may be noted the English stonecrop (*Sedum anglicum*), a pretty white-flowered plant which, though common enough on the west coast, is decidedly rare on the east. Its distribution in Perthshire is rather curious. Near Perth it occurs on Craigie Knowes, and thence is found here and there in Strathearn, is rather common beyond Crieff, reappears at Killin, and occurs at intervals to Fortingall. Auchterarder Station was reached just in time to escape the heavy rain that wound up the day. On making a census it was found that upwards of 230 species of flowering plants and ferns had been observed, in addition to a large quantity of mosses and fungi. This was considered to be a very fair day's work for the time of year.

# PROCEEDINGS

OF THE

# Perthshire Society of Natural Science.

VOLUME I. PART IV.

1883–84.

PERTH:

PUBLISHED BY THE SOCIETY AT THE

PERTHSHIRE NATURAL HISTORY MUSEUM.

MDCCCLXXXIV.

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# SESSION 1883-84.

NOVEMBER 15th, 1883.

Col. DRUMMOND HAY of Seggieden, President, in the Chair.

NEW MEMBERS.

The following were nominated for election at next meeting:—Mr Thomas Chalmers, solicitor; Mr R. Brown, E.C., R.N., Barnhill; Miss H. Salmon, Barnhill; Mr C. G. Kennaway, jun., 47 Scott Street; Mr A. Reid; Mr A. E. Pullar; Mr P. R. Leitham, Tweed Terrace, Bridge of Allan; Mr James Thomson, teacher, Kinnoull; Mrs Macduff, Bonhard.

DONATIONS.

*Index Collection.* Geological specimens—from Rev. P. Macgregor, Logiealmond. Zoological specimens—from Dr Buchanan White; Mr Henry Coates; and Mr Sidney Keith. Botanical specimens—from Professor Trail; Dr Buchanan White; and Colonel Wedderburn Ogilvie of Rannagulzion. Drawings—from Miss Meta Dickson, and Mr Henry Coates.

*Perthshire Collection.* Geological specimens—from Rev. P. Macgregor, Logiealmond. Fish—from Mr Lumsden; Mr T. Marshall; Mr P. D. Malloch; Rev. J. M'Lean, Grantully; Rev. P. M'Gregor, Logiealmond; Dr Buchanan White; Miss M. A. C. M. White; Master F. H. White; and Mr J. Gowans. Slow-worm—from Mr Menzies, Aberfeldy. Rook's nest and eggs—from Colonel Drummond-Hay. Plants—from Colonel Drummond-Hay; Dr Buchanan White; Mr A. Sturrock; Mr W. Martin, &c. Shrew—from Jas. Scott, Methven Castle. Char—from Lady Helen Macgregor, Edinchip. Water Vole—from Mr Thos. Marshall, Stanley. Field Mice—from Mr John Stewart, dentist. Shoveller Duck — from Captain D. M. Smythe, Methven Castle. Mouse—from Mr John Stewart. Brown Hare—from Colonel Drummond-Hay. Rabbit—from Col. Drummond-Hay. Two Barn Swallows and Garden Warbler—from Mr John Stewart. 54-lb. Male Salmon — from Mr C. A. Murray, Taymount. Field Mouse—from Mr James Scott, Methven. Two Weasles—from Mr Murray, Methven. White Mole—from Mr John Young, Methven.

*Received on Loan.* Honey Buzzard—from Col. Ogilvy, Millhill. Kite—from Mr Laidlaw, keeper to Sir Robert Menzies, Bart. A number of Insects—from Dr Buchanan White.

*Donations of Books.* Report of the Smithsonian Institution for 1881. Vols. III. to XVI. of *Gardener's Chronicle* presented by Col. Wedderburn Ogilvy.

EXHIBIT.

Mr Magnus Jackson, photographer, Perth, exhibited a portion of a larch tree which was struck by lightning at Dupplin on the 1st September last. Mr Jackson said that he had seen many specimens of trees struck by lightning, but he never saw one so remarkable as this, nearly the whole of the tree being split up into veneers.

THE CONVERSAZIONE.

The CHAIRMAN gave a detailed account of the arrangements which had been made for holding a Conversazione on the 20th, 21st, and 22nd December, on the occasion of the Museum being formally opened to the public.

The following papers were read:—

1. "*On the Occurrence in Perthshire of Bones of the Red Deer in a Sub-Fossil Condition.*" By Dr Buchanan White, F.L.S.

The antlers, which are laid upon the table to-night, have been presented to the Museum by Mr Matthew of Gourdiehill. Though unfortunately not quite perfect, they form both a valuable and interesting donation. These antlers were found in deepening the Pow or burn which drains part of the Carse of Gowrie, and passes close to Gourdiehill. The depth below the surface level at which they occurred was about 10 or 12 feet, and along with them was a large quantity of other bones and a single antler. The first question that suggests itself is—" How

did these bones come to the place where they were found?" In attempting to answer this, we must enter briefly into the far-past history of the Carse, since the popular idea that these remains have heen hrought down by the river from some of the Highland forests, and deposited in the place where they were found at a time when the Carse lands were under water, is, though perhaps possible, yet by no means probable.

The past history of the Carse may be learnt from the deposits which now fill the valley. What these are, and the details of them, may be found in Professor James Geikie's *Prehistoric Europe*, and I need not enter into a description of them. But I should like to try to hring before you some idea of what a spectator who had taken his stand upon some hill commanding a good view of the Carse would have seen at various periods. I need hardly remark that thousands of years would come and go while the various scenes were being enacted, and that of course before he took up his position the hills had come into existence. In fact, we will go no further back than the Glacial Period.

Scene first—A snow-white plain, stretching away in one dead unbroken level as far as the eye can see. Unbroken silence reigning over all. This would be the appearance that the Carse would have had, could anyone have seen it, at the height of the "Great Ice Age." Though apparently a dead level, the icy plain would really have sloped very gently towards the sea, or rather to the place where the sea would have been had it not been pushed out of sight by the ice. Could the thick mass of ice have been lifted, below it would have been found the clay, resulting from the grinding down of the rocks, which we now call "till" or boulder clay.

Scene second—A tumultuous sea, whose waters dash high up on the slopes of the Carse hills. The Grampians, laden with perpetual snow, gleaming white in the distance. The Tay and Earn swollen "from bank to hrae," and carrying into the sea masses of ice, stones, gravel, sand, and finer sediment. Very little life on the land, but the estuary inhabited by many Arctic animals.

Scene third—A verdant forest covering all the land. Through the pines, oaks, and birches that cover the hills, genial breezes hlow. Here and there a view of the Tay can he got, as it flows gently, between its alder and willow-clad banks, to the now far-distant sea. Through the glades of the woodland wander herds of red deer and wild oxen, feeding on the luxuriant herbage. Suddenly, they speed away, leaving behind them one of their number transfixed by a flint-headed arrow. Some men, clad in scanty garments of skins, appear and drag the carcase to their rudely-shaped canoe.

Scene fourth—A wild waste of waters covering all the low ground. The hills still covered with woods, and glaciers again visihle in the Highland valleys. From these pour down the swollen rivers, leaving much fine *debris* with which they cover up the drowned forest of the valley.

Scene fifth—A wide verdant valley. Human habitations emhowered in hlooming orchards. Steamers passing up and down the river, which, near the sea, is spanned hy a great hridge. A man, hearing a hammer and a note-hook, moves slowly over the ground.

These, then, might have been some of the scenes that our imagined spectator would have seen in the long course of ages. It may he said, however, that this does not prove that the red deer was once an inhabitant of the Carse, and that the occurrence of the antlers now hefore us is not sufficient evidence. If these had been the only remains that had been found this objection might have heen sustained, hut such is not the case. The peat hed, which is evidence of the old forest, extends over all the Carse from Perth to Dundee, huried under from 10 to 40 feet of clay, and in various parts of it antlers and other remains of red deer have been found in sinking wells and making drains. Could more of the peat be uncovered and examined, it would douhtless be found that remains of red deer were very abundant. I think, therefore, we are quite justified in assuming that this animal was once a common inhabitant of the Carse. I may mention that in many other parts of Lowland Scotland, where the red deer does not now exist, its remains have heen found, as well as in the fen-land and other parts of England.

It remains now to say a word or two about the antlers themselves. They are not very different from the antlers of *park-fed* deer of the present day, hut are larger than those of *hill* deer. A hill deer in Scotland has rarely as many as 12 regular points to its antlers, but formerly the average was higher—the degeneracy probably resulting from in-breeding. In these antlers, judging from the one that is most perfect, there seems to have heen 16 or 18 points. You will notice that one antler is somewhat differently shaped from the other, the second and third tines not having exactly the same position in each—a circumstance not unusual in red deer antlers. The length of the right antler (which is the most perfect), measured on the outside curve, is 33 inches. The circumference, just above the first or brow tine, is nearly 6 inches. The second or bez tine is placed close to the first; the third (sometimes called the royal) tine i

situated above the middle. The cup or crown has had at least five branches, but from the appearance of the base of the fifth, which is broken, I am inclined to think that there were six. What remains of the left antler is 26 inches long measured on the outside curve, the circumference above the brow tine being the same as in the right antler. The second tine is placed near the middle of the antler, and the third near the crown. The crown is too much broken to enable us to say how many branches it had. The distance of the inner side of one antler from the other, measured from the base of the crown, is 25 nches; and had the antlers been perfect the distance from one tip to the other would have been about 22 inches.

I mentioned at the beginning of this paper that a large quantity of bones had been found along with the antler. It is very unfortunate that these were not preserved, and it is to be hoped that when other bones are found that they will be all carefully collected.

2. "*Some Results of the Challenger Expedition.*" By Dr Buchanan White, F.L.S.

In this paper Dr White gave an account of his researches among the oceanic insects which were brought home by the *Challenger* Expedition, and which had been submitted to him to report upon. Very little had previously been known regarding these Hemipterous insects, and the genera had to be in a measure re-constructed. They were described as spending their existence darting about on the surface of the ocean by means of their long legs. Points of structure peculiar to these forms were described in detail. The paper was illustrated by specimens and drawings.

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DECEMBER 6th, 1883.

Mr MAGNUS JACKSON, F.S.A.Sc., Vice-President, in the Chair.

NEW MEMBERS.

The following were elected:—Mr Thomas Chalmers, solicitor; Mr R. Brown, C.E., R.N., Barnhill; Miss H. Salmon, Barnhill; Mr C. G. Kennaway, jun.; Mr A. Reid; Mr A. E. Pullar; Mr P. R. Leitham, Bridge of Allan; Mrs Macduff, Bonhard; and Mr James Thompson, teacher, Kinnoull.

The following were nominated for election at next meeting:—Miss Phillips, Tay Street; Mr John Wilson, druggist; Mr R. P. Ramage, British Linen Bank; Mr Alexander D. Drysdale, clerk, General Prison; and Colonel Campbell, Governor, General Prison.

DONATIONS.

The following donations were intimated:—*Index Collection.* Two humming-birds—from Mrs Ferrier, Melrose House; cobra—from Mr Somerville Martin, Calcutta. *Perthshire Collection.* Botanical specimens—from Miss Robertson, Springbank; insects—from Mr Herd; botanical specimens—from Mr Wm. Sturrock, Rattray; specimens of galls—from Mr M. Jackson. *For Library.* 19 volumes *Land and Water*—from Col. Wedderburn Ogilvy, Rannagulzion.

ADDITION TO THE CONSTITUTION.

On the motion of the SECRETARY (Mr John Young), the following addition was made to the constitution of the Society:—"In the event of any surplus arising from the annual voluntary contributions, subscriptions, donations on other income or funds of the Society, the said shall be applied in furtherance of the objects of the Society as above stated, and no part thereof shall be applied in making any dividend, gift, division, or bonus in money unto, between, or among any of the members of the Society." Mr Young explained that by adopting this rule the Society would in future be relieved from taxation, which had hitherto been felt a considerable burden.

The motion was unanimously agreed to.

PROPOSED COMBINATION OF NATURAL HISTORY SOCIETIES.

Dr BUCHANAN WHITE said he wished to ask the attention of the meeting to a subject that might perhaps have important results some day. Possibly some of those present had read the report of the Local or Provincial Natural History Societies which meet every year during the meeting of the British Association, and which was in their library. They would see by reference to a proposition in it that it had some bearing on their own Society, and which he might explain. On reading the reports of Societies in England similar to their own, he had been much struck by the good results arising from combinations of Societies in certain districts. The first that took place was in Yorkshire, which was a large county, and had numerous Natural History Societies. For a time they all worked independently, every town and village being independent of each other. He did not know to whom the credit was due, but it came about that finally

the whole of these were associated under what was now called "The Yorkshire Union of Natural History Societies." This Union still left the independence of each Society to itself, and it had, he thought, about four meetings every year, at which members of any Society could be present, while each Society was represented by delegates. One special feature of these meetings was that the whole business of the Union was discussed, the object of the Union being the investigation of the natural history of Yorkshire. There was another Union, namely, the Midland Counties Natural History Societies, that had also been very successful. He believed they would all agree with him when he said that if they and similar Societies in the East of Scotland were united, they would be able to do more work and promote their general objects more effectually. He was last summer brought into contact with members of Natural History Societies in Dundee and Arbroath, and in the course of conversation some of the members, especially those of the Dundee Naturalists' Society, took up the subject very heartily. The outcome of the matter was that he had had a letter the other day from the Secretary of the Dundee Naturalists' Society, saying that he, Mr Frank Young, and Mr J. Martin White, yr. of Baldruddry, had been appointed a Committee to come to Perth to discuss the question with him. Now, he thought it would be much better that their Society should appear officially in the matter by appointing him as a member of the Committee, and perhaps some other member; so that they would not be outvoted by the Committee of the Dundee Society, when they met to discuss the question of the Union. He thought they could not appoint a better member than their delegate to the Committee of the British Association, who had studied the question of the working of Local Natural History Societies; — he meant Mr Robert Pullar. His idea on the subject was that the Societies included in the basin of the Tay, and perhaps—as Societies in Scotland were not so numerous as they might be—all the Societies in the basin of the Dee and Don, might form a Union of the East of Scotland, the primary object of which would be the investigation of the fauna and flora of that part of the country. Perthshire did not include the mouth of the Tay; so the Dundee Society would cover that ground. He thought that these would very naturally form a fitting union of Societies. As to how the scheme would be carried out, he thought that possibly they might have, in different places in rotation, an annual meeting, where the objects of the Union might be discussed, an excursion made, and so on, and thus promote good fellowship among the different Societies; and by seeing what the other Societies did, it might be a means of spurring themselves on to greater efforts.

Mr Robert Pullar said that he had had the honour of acting as delegate of the Society to the British Association at Southport. He met there a large number of gentlemen who were connected with Local Societies in England and Scotland, and they all spoke of the great benefits derived from forming District Associations. They could not have done half the amount of work had they not been associated in groups. One of the objects of these District Associations, too, was to associate themselves with the greatest Association in Britain—the British Association; and he was glad to think that their Society should be associated with it in the future. One point that the British Association was determined upon was, that they would have no Local Natural Science Society that did not do some work, and publish their proceedings every year or two years; — so that, if they expected to continue to have the honour of being connected with the British Association, it must be understood by the members that some work must be done;—and he thought that it was a very proper thing to want only working Societies connected with them. There would be various benefits derived from being connected with this great Association which he need not dwell upon, but he would only say that he should be very glad to act along with Dr White in the matter to which he had referred.

Mr A. Coates said that the proposition was a most interesting one, and one that would strengthen them in their work in every way. They could not do better than take this preliminary step towards anything further they might do in the matter.

The motion was unanimously agreed to.

The following paper was read:—

"*Dimorphism in Oak Gall-Makers, and in their Galls.*"
By Professor J W. Trail, M.D., F.L.S., Aberdeen.

The subject on which I propose to address you to-night was, like so many others in the domain of biology, almost entirely unknown, even unsuspected, a dozen years ago. It has, within the past five or six years, come prominently forward, as the result of the very careful and painstaking observations of certain entomologists, chiefly in Germany and in France; and it has been found to explain mysteries in the life-history of not a few long-known species of gall-makers,—mysteries that had long baffled the conjectures of all that had given their attention to insects that have been regarded, by most entomologists even, as of too little

interest to attract their study. However, in this, as in most scientific pursuits, familiarity does not lessen the pleasure and interest to be derived from the study; and the explanation of the perplexing mysteries has only added to the inducements already existing to take up the investigation of those creatures. It may almost be said that year by year the phenomena of "dimorphism," in one or other of its various forms, are found to be more and more widely spread among the lower groups of animals; hut among insects it has heen known in comparatively few cases, the Aphides heing the hest group to exemplify it till within late years. It may he said to consist essentially in this, that there are in the full life-history of any species in which it occurs two forms of the insect, or, as it is at times expressed, two generations, of which the one possesses both males and females and produces offspring in the usual way, while the other consists of so-called females alone, and reproduction is effected hy what we may regard as a process of budding from a part of the body of the parent, not hy the true sexual method. This latter generation is really asexual, not (in function) female at all, though frequently it resemhles exceedingly the ordinary female in appearance; and the eggs produced by them are indistinguishable in appearance from ordinary eggs sexually fertilised and developed in the ordinary way. In many cases the asexual generation produces living young ones, as in many or indeed most of the Aphides, by the process of hudding ahove alluded to. It is, however, practically impossible to draw the line hetween the asexual and the sexual methods of reproduction, inasmuch as there are not a few cases known in which true females, if not fertilised in the usual way, are capahle of laying eggs that will go on to develope in the usual course, and will produce healthy offspring. Numerous examples of this have occurred among the Lepidoptera; but perhaps its occurrence is more widely known among the Honey or Hive Bees, in which the unimpregnated eggs give rise to male or drone bees, while the impregnated eggs of the same female produce larvæ capable of heing developed into neuters or into queens, according to the accommodation allowed them in the cell, and to the kind and amount of food given them. Among the Gallmakers this dimorphism or alternation of generations is met with in the groups known as the Gall-flies or Cynipidæ and the Green-flies or Aphides.

Let us commence, then, with the Cynipidæ. These insects are not, on the whole, a very numerous group; and in Scotland, so far as I am aware, their galls have been found on plants belonging to only the genera *Quercus*, *Rosa*, *Hieracium*, *Potentilla*, *Rubus*, *Nepeta*, *and* (?) *Triticum*; but in other countries they form galls on plants of a good many genera besides these. Of all the genera mentioned, one stands out pre-eminently as gall-bearing, the Oaks (*Quercus*) supporting more than half the galls known to be the work of Cynipidæ. Next in frequency to the Oaks, in number of the kinds of galls they bear, but very far behind in numbers, come the Roses. The remaining genera do not, as a rule, hear more than one or two kinds of galls of this group of insects. Those desirous of obtaining a wide knowledge of the galls of Cynipidæ will find that there have been not a few works devoted to their elucidation, either to them exclusively, or to them along with the galls of other groups of insects. Among the most valuable of these special works may be noted the following;—*Die mitteleuropæischen Eichengallen; Europæischen Cynipidengallen*, and other very excellent papers by Dr Gustav Mayr, of Vienna; Dr Adler's now well-known paper on the *Dimorphism of the Cynipidæ*, either in the original German or in the translation into French hy M. J. Lichtenstein; Hartig's *Ueber die Familien der Gallwespen;* Beyerinck's *Die ersten Entwickelungsphasen einiger Cynipidengallen;* various papers by Mr Peter Cameron, of Glasgow, in the *Etomologist's Monthly Magazine* and in *The Scottish Naturalist*, some articles by myself in the same magazines; and several articles by Walsh, Bassett, Fitch, and other American entomologists. But even an enumeration of the papers that would require to he consulted to gain a thorough knowledge of the life-history and of the systematic arrangement of the Cynipidæ would only be tedious at this time, nor could such an enumeration serve any good object here.

It may he not amiss to note in passing that the Cynipidæ, though all helonging to the group popularly and *par excellence* known as Gall-flies, are not by any means universally makers of galls. Many of them are *inquilines*, *i.e.*, they live as (unwelcome) guests in the galls formed hy the gall-making species; hence in rearing the insects from the galls, it is necessary to exercise not a little caution in regarding all and sundry Cynipidæ that emerge from them as being gall-makers. We should soon have far more than "*di*morphism" among them if led astray hy any such error of ohservation. It may be that these inquilines are descendants of true gall-making species, which have found it more easy for themselves to take advantage dishonestly of their kinsfolk's labours to provide themselves with food and shelter, as is indeed exemplified not seldom in the higher animal—man. They are often closely allied to gall-making species. Other Cynipidæ have taken to still less creditable modes of gaining a living, and have hecome degraded into the condition of true parasites, like the Ichneumon flies in that

respect, though still retaining the essential characters of structure of the Cynipidæ.

The true gall-makers are found on both the European and the North-American sides of the Atlantic, though as yet apparently more abundant in Europe than in America. Probably this is due in great measure to the larger number of entomologists and botanists in Europe by whom these curious structures have been studied. To an American entomologist is due the credit of having been the first to discover the existence of "dimorphism" in any insect of the Cynipidæ; Mr B. Walsh having published in 1870 (*American Entomologist*, vol. ii., p. 330), a paper describing the life-history, as deduced from his own observations, of the supposed species *Cynips aciculata* o.s. and *C. spongifica;* and showing that there was reason to regard them as merely generations in the development of a single species. Little need was paid to this discovery for several years, as it stood as an isolated, and therefore distrusted, statement. In 1877 Dr Adler first published a brief announcement of the results of carefully-conducted experiments and observations made by himself on several different species of European Cynipidæ; announcing that in a number of the Gall-makers on Oaks, in each species there are two quite distinct forms, giving origin to two usually very different forms of galls; that the forms are exclusively confined to different periods of the year in their development; and that the insects of the two broods are often so distinct from one another in appearance, and even in structural characters, that they have been described as distinct from one another, not only specifically but even generically. He published not long afterwards the results of longer continued labours in the same line, and as the result of these he asserted that a number of the so-called species of preceding systematic writers are simply stages in the full cycle of development of other species earlier described and named as distinct. In this way the number of species would have to be considerably reduced, but, as already stated, difficulties in the life-history of not a few species have been cleared away by the new views put forward by him. Of course, Dr Adler's announcements were at first received with hesitation, so novel were they; nor is there good cause for anything like complaint that revolutionary ideas should make their way with some difficulty, and that they should be well sifted before they are generally accepted as received truths. But while it is well that due caution should be exercised in their reception by those to whom they are presented for the first time, and who have not had the opportunity to verify them for themselves, so much the greater honour must we ascribe to him, who, in the face of distrust and opposition, proves his accuracy and wins general recognition of the value and trustworthiness of his discoveries. This Dr Adler may be said to have fully succeeded in effecting.

It is a noteworthy and rather curious fact that dimorphous Cynipidæ are known as yet only among the gall-makers that live on the Oaks (with the exception of one on Maples); but even among them this peculiarity is by no means universally met with.

It may be well, before entering into details of the life-history, as traced by Dr Adler, of any of our native Cynipidæ, to dwell a little on what was known previous to 1870 about the life-history of these insects, and of the course of development of their galls, as the problems in connection with their development will be thereby seen more clearly as they presented themselves to inquirers of that period, and the advance made by Mr Walsh and Dr Adler will be better appreciated.

In what I may have to say in respect to the Cynipidæ, I shall confine my remarks exclusively to those that cause the numerous galls on oaks, and shall as far as possible refer to common and widely-known Scottish galls and their makers. I shall also have to indicate the results of the new views as relating to our Scottish oak-galls, and to point out what forms we may look for that have not been recorded for Scotland, but that must occur with us, if Dr Adler's identifications of the two forms are correct in all cases. Several galls are known from Scottish localities, the corresponding forms to which, *i.e.*, the second generation, have not yet been found here; hence it is of interest to attend specially to such forms, alike because they are definite objects to be sought out, rendering more complete our knowledge of our native fauna, and because if, after careful search, they cannot be found here, their absence may enable us to correct errors in detail in the identifications that have been determined or suggested in the group; and correction of errors is of no less value than actual advance and addition to our knowledge.

Even the least observant must be quite familiar with several of the numerous very different galls that are frequently so abundant on our native oak-trees; and probably the question has suggested itself to almost every non-scientific, as well as to every scientific observer, what could be the cause of their production. There are probably few persons now-a-days that are not aware that insects have to do with their production, in some ill-understood manner; but probably most non-entomological inquirers have rather a vague idea of the appearance of the insects themselves, though the desire of knowledge may have led them so far as to have cut open galls, and have so familiarised them with the fact of a small pale-

coloured maggot existing in the centre of each. It may be that some may go farther in their desire for knowledge, and may collect some of the galls, particularly of the hard woody forms, and, putting them into some secure receptacle, may allow them to remain in it till the following spring, occasionally glancing at them to see what results from them. After a time, in most cases, there will be found along with the galls some small four-winged flies, belonging to the Hymenoptera; but though naturally we might be inclined to suppose that these are the makers of the galls, it will be remembered from what has been said above, that this conclusion may be erroneous. Besides the gall-makers the observer will often find among the insects that emerge from the gall allied Cynipidæ, some of which are simply guests reared from eggs of species that do not form galls for themselves, but only lay their eggs in the galls made by the true gall-flies. Other species may belong to a group of Cynipidæ that have developed the habit of parasitism, not being mere guests as in the former cases, where the guests may indeed destroy the legitimate occupant of the gall by eating all the food that ought to be available for its nourishment, but do not wilfully injure the true owner. The parasitic species, properly so-called, on the contrary, destroy the gall-maker, as the latter is the food on which the parasitic larva lives. But besides these Cynipideous guests *(inquilines)* and parasites, there may be numerous insects of other groups reared from the galls; and among these are to be found both guests and parasites, no less than among the species more nearly related to the gall-makers. Many of these other insects are small Hymenoptera, belonging to groups *(Encyrtidæ, Torymidæ, Chalcididæ)*, that have a considerable resemblance to the Cynipidæ, though others are more widely different in their aspect, some of the latter even belonging to the smaller moths or to beetles. Indeed, a list of the insects that have been reared from, for example, the large round marle-like galls of *Cynips Kollari* Hart (the "Devonshire gall"), now so widely spread in Scotland, would certainly much surprise even an entomologist, if he had not previously directed any attention to these bodies and their occupants. It will be understood from what has been said that the determination of the gall-makers is not so easy a task as might at first be imagined, and as might be believed from the ease with which insects can be reared from many of the oak-galls. The identification of the insects when reared can be effected with certainty only by a special adept, inasmuch as the general similarity between undoubtedly distinct species of Cynipidæ is extremely close in many cases, while frequently the different broods of a dimorphic species are more unlike one another than they are to allied species. Mr Cameron stands pre-eminent in Scotland, I may say in Britain, in this difficult task; and to his labours do we owe much of our recently-acquired knowledge of Scottish Cynipidæ and their galls.

On referring to the older writings that treat of galls, such as Reaumur's and De Geer's works, we find that oak-galls occupy a very prominent place among the forms spoken of. Many of the figures and descriptions in these works are exceedingly good, and show a keen power of observation; but naturally the knowledge of the writers as to the origin of the galls was somewhat uncertain. In some of the older works the ideas suggested as to their origin, and as to the mode in which the larvæ usually found in them (on cross section) gained admission to their interior without leaving any external mark of the passage through the tissues of the gall, are often very amusing in what we now regard as their absurdity. However, it is needful for us to remember that we are still in little less darkness than our predecessors as regards many of the most common and necessary functions of life, and that many of the so-called explanations at present in vogue will probably seem to our successors as absurd as anything to be found in the works of those to whom, with all their errors, we owe the possibility of the great advances that have been made since they lived and laboured in the mists of perplexity, with little to aid them in their efforts to reach the truth. Small though their progress may often seem, it was great if measured by their opportunities and means of investigation, and they rendered the attainment of truth possible by clearing away the mass of error that had so greatly prevented their own advance.

Among the different forms of oak-galls that must be familiar to almost all my hearers are several that I may recall to recollection in a few words devoted to each. Galls on oaks, the work of true gall-flies, are found on all parts of the tree, from the roots to the parts of the flower, each kind usually being restricted to some one set of organs of the tree; for example, the lenticular rusty brown "oak-spangles" are seldom, if ever, met with on any part but the leaves, though so common that there are very few leaves on which one or two may not be found in most places in the month of September; and many leaves are so loaded with them on the lower surface, to which they are confined, that hardly a spot the size of a pin's head is left free from them. Many galls in like manner are exclusively confined to the buds, such as the "Artichoke gall," which derives its name from its great likeness to a small artichoke. A comparatively small number of galls may be found on more than one organ of the plant. As an ex-

ample of these may be mentioned the "Currant galls," so common in the months of May and June throughout the whole country. These galls are very generally found on the leaves, projecting from the lower surface, hut also visible above; hut they very frequently occur on the male inflorescences, several usually being present on each of these. In this situation they look very like fruits, as each gall is usually much like a red currant in size, form, translucency, and colour; and it is to this fact that the popular name is due. Indeed I have been asked at times whether they were in reality not fruits, the larvæ heing taken for intruders.

Dividing the galls on oaks that have yet heen recorded from Scotland (including two or three found lately hy myself, but not yet recorded), into groups according to the organ of the tree on which they are found, I shall briefly describe them, treating each form for the present as distinct from every other. I shall afterwards return to the relations of the dimorphic species to one another.

*Root-galls.* Of these there are few known from Scotland. Mr Cameron has found the following in the neighhourhood of Glasgow:—

*Aphilothrix radicis* Fab. the gall forming a rounded or irregularly pear-shaped hody affixed to one of the roots. It may reach an inch or two in diameter, is at first pale and rather fleshy in texture, hecoming brown and woody as it dries up, and on section is found to contain numerous oval cells, each enclosed in a thin hard wall, and each containing a single larva. These galls are formed in late summer. The insects reared from them are bisexual.

*Biorhiza aptera* Fab. produces galls on the roots also; these galls vary much in size, the individual galls being usually about the size of a pea, and rounded in form, but generally they are crowded in masses of considerahle size, and may then be very irregular in form, and often more or less completely fused together; externally they are reddish in colour; their consistence and internal structure are much as in the former species. Both are difficult to find, and require continued and careful search; hut they are prohahly pretty widely diffused in Scotland. The galls of *B. aptera* are formed in late summer, the insects emerging in winter. They are wingless, and are all asexual.

*Bark-galls.* Of this group, only two species found with us. *Andricus nonduli* is a very inconspicuous form, consisting merely of slight thickenings of the twigs of oaks. The bark is raised up here and there in small warts, or more generally, so many occur in the twig that for part of its length it becomes distiuctly thickened and irregular in form. The presence of the galls is most readily detected after the iusects have emerged by the existence of the small holes of exit. On making a section of a galled twig the galls are found to he situated in the bark. They are formed in early summer. The insects are asexual, and emerge from the galls in spring.

*Aphilothrix corticis* L. forms galls imhedded in the hark of oaks. The callns formed over the stumps of felled trees or of lopped branches seems to he rather a favourite sitnation for the insects to select. While fresh the galls appear only as hemispherical or oval swellings, fleshy in texture, and covered with a reddish-yellow skin. The actual gall is situated helow the level of the bark, is quite hidden, and has a compact special wall, the upper end of which separates away as a scale when the insect is ready to escape. The fleshy swelling also falls off, leaving free exit for the insects. The galls are formed in autumn, and the insects (asexual) emerge in spring. The old galls remain in the bark for a long time after the escape of the insects. Mr Cameron records them as rare at Kenmuir.

*Bud-galls.* This group contains a considerable number of forms, all of which agree in the fact that they are formed by the alteration of the growing point of a hud, either latent, or attacked while in active growth. Many of them are very inconspicuous, and require to he closely sought for ere they can be found, as they often remain almost or altogether enclosed in the nearly unchanged bud-scales; and when mature they fall to the ground, where they are so inconspicuous as to defy search. Others, on the contrary, are among the most conspicuous of oak-galls, *e.g.*, the "Devonshire gall" and the "Artichoke gall," already quoted.

*Trigonaspis megaptera* Panz. produces galls in early summer in many parts of Scotland. These galls, at first sight, seem to he attached to the lower part of the trunk of the tree, apparently to the bark directly; but on careful examination each will he found to he in reality a hud-gall, though generally the hud is extremely ill-developed. The galls vary in size from about one-fourth to almost one-half inch in diameter; they are irregularly rounded, or may become polygonal from mutual pressure or from pressure on the hark of the tree. Frequently they are sunk in the moss so commonly met with on tree-trunks, from which they show as small pink bodies; but they may vary a good deal in colour. They are rather fleshy in texture; and on section are found to have hardly any well-defined denser wall surrounding the central cavity. The insects usually emerge from them in the month of June. They are of hoth sexes, and a moderate amount of difference in appearances exists between the sexes.

*Cynips Kollari* Hart. The "Devonshire gall" is one of the most widely-known of all our species. It is believed to have heen introduced into Britain; and was first noticed in ahundance in Devonshire, whence its popular name. It now occurs in many parts of Scotland, at least as far north as Forres, and is by no means scarce in Aberdeenshire and Banffshire. The galls are ahout the size of common marhles, such as boys amuse themselves with. As they remain attached to the twigs for years they are very conspicuous, and the more so as a twig may often have from six to a dozen on it. Single galls are almost perfect spheres, the surface being smooth or with only a few small warts scattered over it. When young they are yellowish-green and rather fleshy; but they turn a pale brown, and become dry as they get older. The central cell is relatively very small, as the walls are extremely thick, the greater part of the wall heing made up of soft spongy tissue, with only a thin external and internal shell hard and compact. A very large number of kinds of insects have heen reared from these galls, of which the greater number are guests. The gall-makers are almost without exception female, or, rather, asexual. Many thousands of them have heeu reared.

*Aphilothrix gemmae* L. is the maker of the conspicuous "Artichoke gall," extremely common in many localities. The galls look very like miniature artichokes, as they are covered with the enlarged hud-scales one above the other, till they may reach an inch or more in length hy $\frac{5}{8}$-inch in hreadth. Their form is regularly conical. In the centre, concealed hy the scales, lies a little rifle-hullet-shaped body, the true gall, consisting of a compact shell surrounding a rather large space, in which the larva lives. These galls are formed in autumn, and the insects emerge in spring. They are all asexual.

*Aphilothrix solitaria* Fonsc. makes galls of an ovate form, ending in a prominent tip, ahout $2\frac{1}{2}$-$3\frac{1}{2}$-lines long hy rather over half as much in breadth. Their surface is nearly smooth, and is green or hrownish. The wall is thin but compact. The insects emerge in August, and are asexual. These galls have heen found by Mr Cameron near Glasgow, and hy myself on Deeside; they are more or less enveloped in the bud-scales, and are therefore apt to he overlooked.

*Aphilothrix autumnalis* Hart. Of this species the distrihution in Scotland, so far as yet known, is the same as in the last case; but the gall is still less easily detected, as it is almost entirely surrounded by hud-scales, until, in late autumn, it falls to the ground, where it lies all winter. The gall is ovate, about 1-7th-inch long by 1-10th-inch broad, brown and smooth. The galls are formed in autumn, and the insects emerge in spring. They are asexual.

*Aphilothrix collaris* Hart. forms extremely inconspicuous hud-galls, that remain entirely hidden among the bud-scales. They are spindle-shaped or ovate, ending in a conical point, 1-6th-inch long and 1-12th-inch hroad, smooth and hrown, and very thin-walled. They are formed in early summer, the insects, which are asexual, emerging in the end of May or in June. As yet, owing no douht to their want of conspicuousness, these galls have heen found in Scotland only hy myself, in one or two places near Aherdeen.

*Aphilothrix albopunctata* Schl. is another of the makers of inconspicuous hud-galls, and, like the others, has been found in Scotland only by Mr Cameron and myself in our respective localities, though it will doubtless prove to be not uncommon when looked for elsewhere. The galls now under notice are almost entirely enveloped in the bud-scales, from which they fall out when ripe. They are oval or ovate, ahout $2$-$2\frac{1}{2}$-lines hy 1 1-5th-1 3-5th-line, smooth, and green or hrown, with numerous short white streaks. The wall is rather thick. The galls are formed in spring, and fall to the ground towards the end of May, while the insects are said to emerge from them in late autumn, or in the following spring. They are asexual.

*Aphilothrix callidoma* Hart. also makes bud-galls in the axils of the leaves; but differing from those previously described in being supported on long stalks. They are not unlike a barleycorn in size and appearance, with a red or green surface, changing in colour to hrown, and either provided with several longitudinal ridges, or smooth, with a thin coating of white hairs. The wall is rather thin. The galls are found in autumn, and have been recorded hy Mr Cameron from Inver Moriston. The insects are asexual.

*Dryoteras terminalis* Fabr. causes the "oak-apples," more generally known in some parts of England than among us; though, from their size and bright red colour, they are sufficiently conspicuous to attract the notice of even the least ohservant. They are generally situated on the smaller hranches, forming masses of an irregularly-rounded outline, often reaching $1\frac{1}{2}$-inch in breadth. The surface is smooth, and velvety in texture. It is of a yellowish-green colour, with usually one side red, as in an apple. On making a section through the gall, it is found to he fleshy and full of sap, and contains in its central part a numher of cavities, each surrounded by a compact wall, and each tenanted by a larva. These galls are formed in early summer, and the insects emerge during the summer. They are of both sexes. The galls dry up after the insects have left them, but their

remains are often to be seen on the trees for several years.

*Andricus inflator* Hart. is one of our rarer Scottish gall-makers; but its galls have been found by Mr Cameron near Glasgow, and by myself on Deeside, in the month of July. They appear as terminal swellings on the young twigs. On section this swelling is found to enclose a cup-shaped cavity, in the bottom of which lies a tiny egg-shaped brown body, with a wall hardly thicker than a sheet of paper. This inner body is attached to the cup only at one point, and is very easily separated from it when mature, so as to lie loose in the comparatively large hollow of the cup. The larva lives inside this inner gall. The cup is closed above only by a thin membrane. The insects emerge in July, and are of both sexes. The galls of this insect are often simulated rather closely by a much more common gall, that of *A. curvator* Hart., when these occur, as they do at times, in the twigs. As the latter galls are far more commonly found on the leaves I shall defer saying anything more about them for the present.

We come next to the galls formed upon the leaves, either on the lamina, the leafstalk, the midrib, or the leaf-veins. Of these, numerous species have been recorded from Scotland, some of them being large and showy, others small and inconspicuous.

*Dryophanta folii* L. is the maker of the large round galls, resembling marbles in size and form, that are common on Kinnoull Hill and elsewhere in Perthshire, and which I have also found near Forres, in autumn, on the backs of oak leaves. From their size they cannot be mistaken for any galls but those of *Cynips Kollari*; and from the latter they are easily distinguished by their situation (on the leaves), their bright red or yellow colour, and their softness. The walls are very thick, and spongy in texture; and show no true inner gall. The insects emerge during winter from the galls, and are asexual.

*Dryophanta longiventris* Hart. forms galls resembling the last in general appearance, but smaller, being the size of rather large peas, and characterized by their colour being red, with broad yellow bands, which may be raised above the level of the rest of the gall. These bands surround the gall. In texture and structure this gall much resembles the last. The insects are said to emerge in November, and are asexual. Mr Cameron records these galls as rare, at Cadder, near Glasgow.

*Dryophanta divisa* Hart., unlike the last, is one of the most abundant of gall-makers. We may sometimes see small oaks with a dozen or more of them on almost every leaf, and it is seldom that only one occurs on a leaf. They are restricted to the lower surface, where they are attached by a point to the midrib or to the side-veins. The form is that of a sphere considerably flattened, and often somewhat irregular. The surface is smooth and shining, or has small flattened warts scattered over it. Its colour is pale yellowish-brown, often with one side red. The wall is not relatively very thick, and it is much more compact than in the allied species. In size the gall seldom exceeds $\frac{1}{3}$-inch in diameter. The insects emerge in June, and are asexual. The galls form in autumn.

*Neuroterus lenticularis* Ol. is the maker of the "oak-spangle" galls so universally abundant wherever oaks are to be found in the wild state. They seldom, indeed hardly ever, are to be seen on the upper surface of the leaves, though frequently there may be scores crowded as closely as they can lie on the lower surface, so closely that they overlap one another on all sides. Where they have room to assume their characteristic form they are seen to be flat or lens-shaped from above downwards, and circular when looked at from above, with a slight elevation towards the middle. I have never seen them exceed $\frac{1}{4}$-inch in width by about half as much in thickness while on the leaf. The surface is rusty red owing to the existence of tufts of stellate short hairs, and the side next the leaf is smooth. These galls appear in July or August. They fall to the ground shortly before the leaves themselves fall, and lie concealed amidst the fallen leaves during the winter. While on the leaf, the central cavity, in which the larva lives, remains very small; but during the winter it enlarges, and the gall becomes highly convex. The insects pass through their metamorphoses while the galls are on the ground, and emerge in the following spring. They are asexual.

*Neuroterus fumipennis* Hart. makes galls very similar in form to those just described. They may easily be recognised by being smooth, with little trace of hairs, and pale green, or red if on the upper surface of the leaf, though this is not their usual situation. Generally there are not more than six or seven on a leaf, and very seldom are two of the galls in contact. They pass through a similar development with the former, the insects emerging in spring, and being asexual. These galls are not very general in Scotland, and seem almost restricted to the south side of the Grampians.

*Neuroterus numismatis* Ol. is very common in most parts of Scotland, though in a few localities it seems rare or local. The galls are scattered, or may be crowded in scores, on the back of the leaves. They are of very peculiar appearance, and have received the name of "silky-button galls" from their singular resemblance to the small silk buttons, with a central hollow at the top, so commonly

used in trimming ladies' dresses. The galls seen from above are round, not exceeding ⅛-inch in breadth, and in the centre there is a considerable circular depression. Seen from the side, they are flattened on the side next the leaf and slightly convex above. The surface is covered with fine silky shining brown hairs, directed downwards over the rounded sides. In section they are found to enclose a small lens-shaped cavity below the depression, and in this the larva lives. The galls are developed in autumn, fall to the ground and lie among the dead leaves all winter, and give birth to the asexual insects in the following spring.

*Neuroterus ostreus* Hart. is pretty widely distributed in Scotland, especially in the southern districts; but it can hardly be said to be anywhere abundant. The galls are situated on the midrib, or on the chief veins, seldom more than three or four occurring on a leaf. They seem to be restricted to the lower surface. They are oval, attached by one side, about 1-7th-inch long when full-grown, and quite smooth and shining. At first they are greenish, afterwards becoming yellow, with numerous small dots of red or violet-red. Each gall is partially enclosed at the base by two membranous lappets that seem to be the ruptured epiderm of the leaf-rib. The wall is not thick, but is very compact. The galls are formed in the latter part of summer, and in autumn they fall to the ground, where they lie all winter. The asexual insects emerge from November till next spring.

*Biorhiza renum* Hart. is common wherever I have looked for it at the proper season. Owing to its small size, the gall is by no means conspicuous, nor does it continue long on the leaves. The galls appear in September. For some time they remain very small, not so large as pinheads; but as they are usually found in masses of six or more on the veins of the lower surface, they may be detected without difficulty when looked for. After a time they enlarge to three or four times their former size, change from kidney-shaped to nearly globular form, and lose their former greenish hue, becoming nearly white. They fall to the ground, and the asexual insects emerge during the winter.

*Spathegaster baccarum* L. is the maker of the "currant galls of the oak," which must have been noticed frequently by every one during the month of May, hanging on the male catkins like bunches of currants, or, more commonly, growing on the leaves. In the latter situation they are fixed by a broad base, which projects through to the upper surface of the leaf, while the globular gall, frequently as large as a sloe, projects chiefly from the lower surface. Frequently two of the galls are more or less completely fused together. The surface of the gall is quite smooth, and is green with red or purplish-red irregular mottlings. They have a translucent appearance, like the red or white currants. The walls are relatively very thick, and are extremely full of sap; hence, after the escape of the insects, the galls shrivel up to a very small size. There is hardly any trace of a distinct inner wall. They are formed as soon as the leaves begin to burst out from the bud in spring. They grow rapidly, and in the course of a week or two have reached their full size. The insects emerge in June and July; and there are both males and females among them.

*Spathegaster tricolor* Hart. has been found by Mr Cameron in various localities near Glasgow; but I have not myself seen it in the North of Scotland. The galls are spherical or nearly so, about 1-5th-inch in diameter, covered sparingly with long slender simple white hairs, and rather fleshy in texture, with a moderately thick wall. They are formed in May, and the insects (males and females) emerge in July.

*Spathegaster albipes* Schenck. is recorded by Mr Cameron thus:—"I find it commonly around Glasgow. The very small size of the gall renders it easy to be overlooked" (E.M.M., vol. xiii., p. 200). The galls are situated on the margin or on the midrib (causing distortion) of the leaf. They are oval, about 1-12th-inch long by half as much in breadth, and attached by one side. At first they are slightly hairy, afterwards becoming naked, and are greenish in colour, passing into yellow. They are produced almost with the earliest appearance of the leaves; and the insects (male and female) emerge in the end of May or in June.

*Spathegaster verrucosa* Schlecht. is another of Mr Cameron's discoveries, he having found the galls in Mugdock Wood (Proc. N.H. Soc., Glasg., vol. v., p. 158), on the leaf-buds and the young leaves. They are affixed to the veins or midrid, are spindle-shaped or clavate, end in a blunt tip, and may reach a size of 1-5th-inch by 1-10th-inch. The surface is smooth, bluish green, becoming greenish-yellow, with red markings, and is covered with bladdery simple hairs. The wall is relatively thin, and has no distinct hard inner layer. The galls are formed as the leaves appear; and the insects (male and female) emerge in the end of May or in June.

*Spathegaster vesicatrix* Schlecht. is probably general in its distribution in Scotland, though as yet recorded only by myself for the North-east and Forres, and by Mr Cameron for Glasgow. I have seen it around Perth and near Dumfries. The galls are sunk in the leaf, so that they are not at first readily recognised as galls. There is only a convexity on each surface of the leaf, enclosing a lens-shaped space in which the larva lies. The gall is circular, not exceeding ⅛-inch in diameter, with a small

knob in the centre, from which fine lines radiate to the circumference of the gall. They are otherwise quite like the surface of the leaf. They are formed early in summer; the insects (male and female) emerge in the beginning of July; and the galls thereafter become straw-yellow in colour, and are, therefore, much more conspicuous than before.

*Andricus marginalis* Schlecht. Under this name has been described a gall that occurs commonly in many places in Scotland on oak-leaves, attached to the side of the midrib, and causing a break in the leaf-blade at such places. There is good reason to regard it as a variety of the gall of *Andricus quadrilineatus* Hart., found in the typical form attached to the male catkins. It is identical in appearance and structure with the latter; hence a fuller description need not be entered on here.

The next group of oak-galls, viz., those on the male catkins (therefore modifications of the stamens), is less numerous than the last.

*Andricus æstivalis* Gir. has been recorded by Mr Cameron from Ardlui, as of rare occurence. The galls are crowded together on a short thick flowerstalk, in such a way as to resemble a mulberry, the mass reaching as much as 1½-inch in length by over an inch in breadth. The separate galls are wedge-shaped at the base, and polygonal from mutual pressure, and may reach nearly ½-inch in length by ⅓-inch in greatest breadth. The apical part of each is free, and ends in a kind of cup with an irregularly lobed margin. They are greenish-yellow, or red. The centre of the cup is filled with a woody mass, in which are some cavities for larvæ. The galls are formed in early summer; and the insects (male and female) emerge in July.

*Andricus ramuli* L. is the maker of very conspicuous galls on the catkins, strikingly similar to balls of white cotton, from ½-inch to 1 inch in diameter. A closer examination shows that this mass is made up of a large number of galls, about the size of a seed of the common whin, thin-walled, hard, and each covered with a coat of long, dry, twisted flattened hairs like cotton fibres. At times isolated galls may be found on the catkins. They are formed in May and June, and the insects appear in July, and include males and females. The distribution of this gall seems somewhat arbitary. It is common in various places along the Dee, near Aberdeen, and Mr Cameron records it from Strathglass. [It has been found on trees on the North Inch of Perth.—EDITOR.]

*Andricus amenti* Gir. forms very inconspicuous galls, hardly more noticeable than the stamens among which one finds them. They are ovate, not exceeding 1-12th-inch in length by half as much in breadth; and are marked with a slight furrow down the middle on each surface. They are brown, covered with very short stiff hairs, and very thin-walled. There are usually several on each catkin. As with the other catkin-galls, they are developed in May and June, and the insects (male and female) emerge in June and July. These galls are far from rare at Ballater on Deeside; they have been recorded by Mr Cameron from Rannoch; and Dr White sent me specimens from near Dunkeld some years ago.

*Andricus quadrilineatus* Hart. is very common near Aberdeen. I have found the galls in Forfarshire and in Perthshire, and Mr Cameron records them as common near Glasgow. They show a considerable degree of variability in form and markings, especially when dried; and several of these forms have received names as distinct species, besides *A. marginalis* already noticed. In the typical condition they are attached to the male catkins, usually four or five on each. The usual form is oval, and the usual size about ⅛-inch by ⅛-inch. The surface is smooth, green, or green with red streakings, and faintly striated, or with no markings while fresh. On drying, the fleshy outer part of the wall shrinks on the ridged woody inner gall, and thus ridges appear on the surface forming a network, the arrangement of which has been employed to distinguish the supposed species from one another. The galls are formed in May and June; and the insects (asexual exclusively) emerge in the following spring.

The only other oak-gall formed by a gall-fly that has been recorded as Scottish is found in the fruit.

*Andricus glandium* Gir. attacks the acorns, but does not cause any marked external deformity in them. On cutting open a galled acorn one finds in the interior a number of cavities of an oval or polygonal form, and about the size of whin-seeds, each enclosed in a thin hard wall. Mr Cameron records these galls from Cadder and from Ardlui. The same species forms galls on *Quercus Cerris* on the Continent and in England. The larvæ remain in the galls for years after they are gathered without undergoing any change.

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If now an analysis be made of the galls just described, it will be found that they may be divided into two great groups. First, those that appear in spring or early summer, and from which the insects emerge usually in the months of May, June, and July; and second, those that appear only in autumn, become developed before winter, and fall to the ground, on which they pass the winter, often increasing in size for a time. From these latter the in-

sects emerge in winter or in early spring. There are, it is true, a few that hardly can he said to fall properly into either of these groups, but the exceptions are so few that they may he left out of view for the present. I am not aware of any case in which two broods of a gall are developed in the same summer. The insects reared from all the galls described ahove are sufficiently different in appearance and in structure to he recognisahle with certainty by an adept; and even to allow of their heing divided into genera hy means of certain structural characters, for the most part dependent on differences in the structure of the ovipositor and adjacent parts, though extending to other parts also, as, for example, to the development or functionless state, or even the ahsence, of the wings. It will have been ohserved that the insects reared from many of the galls are known to be of hoth sexes in the same hrood, hut that in the case of many of the galls, insects of one kind only have heen reared, belonging to the form that I have throughout referred to as asexual, *i.e.*, capahle of laying eggs without impregnation, from which the next generation are developed in the usual course of metamorphosis. The question arises at once whether it is probable that this is the constant condition of any species of insect, inasmuch as it may he regarded as a law seldom, if ever, hroken, that, in the development of organisms of so high a type as insects, a continued process of reproduction without a possihility of, at least occasional, crossing, is unknown. This is one of the prohlems to he solved.

Another prohlem at once meets us, when the matter is looked at from the side of the galls, and that is this. We have already seen that many of the galls are developed only early in spring or in summer; and that the insects emerge not later than July. There is no reason to suppose that the imagos continue to exist for any length of time, certainly not till the following spring. How, then, are the galls produced at the proper season in the following year? For example, the currant galls of the oak are produced on structures that can scarcely he said to have been even beginning to be formed at the time of flight of the gall-flies in the previous year, nor is it conceivable that the parent insect could have punctured the part on which the gall is to be formed in June of the previous year. Even could the insect have done so, it is necessary to suppose that the egg lay dormant, and that no effect followed for many months; a supposition entirely unsupported by any kind of proof. The same difficulty meets us of course with the autumn galls, such as the "oak-spangles," and other common species, though at first the difficulty here may not seem so great. Both these problems were felt to be unsolved in the life-history of the gall-flies previous to the discovery of the "dimorphism" of both the insects and their galls, hut that has solved them for many species already, and prohably will do so for all ultimately.

The method of investigation has heen as follows. Galls of any given kind have heen collected, and the insects reared from them, and placed either on young oaks in pots, or upon branches of older trees enclosed in gauze for the purpose of preventing at once the escape of the insects under ohservation, and the possibility of access of other species that might lead to false conclusions hy forming galls of a kind different from those helonging to the species in question. The insects are watched while laying their eggs, and the buds, hranches, or leaves are at once marked in some way so as not to injure them. They are then watched to see what result may follow. From these ohservations the life-histories of many of the gall-flies have heen traced by Dr Adler; and the conclusions have heen verified alike by himself and by others, hy the frequent repetition of the experiments, under precautions and variations such as to preclude error. He found that in many, indeed in most, cases the gall that followed the puncture of any given species (using the term as it was understood in the group of Cynipidæ hefore his experiments) was not like that from which the insect had emerged; hut that it belonged to some distinct form, in a few cases different from any previously known, hut generally helonging to what had heen regarded as a perfectly distinct species; and in every case this second form of insect had heen referred to a different genus from the former. This will he rendered clearer by tabulating the results for our Scottish Cynipidæ and their galls. They are as follows, the forms under each not yet found in Scotland being given in brackets; these ought to occur with us also, assuming Adler's conclusions to be correct, and should he looked for wherever the corresponding form has heen already met with:—

| *Asexual.* | *Emerge.* | *Sexes distinct.* | *Emerge.* |
|---|---|---|---|
| Aphilothrix radicis | Spring. | Andricus noduli | Autumn. |
| ,, corticis | ,, | ( ,, gemmatus) | ,, |
| ,, autumnalis | ,, | ,, ramuli | July. |
| ,, collaris | ,, | ,, curvator | June. |
| ,, gemmæ | ,, | ( ,, pilosus) | ,, |
| ( ,, globuli) | ,, | ,, inflator | June, July. |
| Dryophanta folii | Winter. | (Spathegaster Taschenbergi) | June. |
| ,, longiventris | Nov. | ( ,, similis) | ,, |
| ,, divisa | ,, | ,, verrucosa | ,, |
| Neuroterus lenticularis | Spng. | ,, baccarum | ,, |
| ( ,, læviusculus) | ,, | ,, albipes | ,, |
| ,, fumipennis | ,, | ,, tricolor | July. |
| ,, numismatis | ,, | ,, vesicatrix | June. |
| ,, ostreus | Winter. | ( ,, aprilina) | May, June. |

| *Asexual.* | *Emerge.* | *Sexes distinct.* | *Emerge.* |
|---|---|---|---|
| Biorhiza aptera | Winter. | Dryoteras terminalis | July. |
| ,, renum | ,, | Trigonaspis megaptera | June. |

FORMS OF WHICH THE RELATIONS HAVE NOT YET BEEN DETERMINED.

*(a) Asexual.*

Aphilothrix solitaria.
,, Clementinae.
,, callidoma.
,, albopunctata.
Cynips Kollari.
Andricus quadrilineatus.

(In most of these the galls are found in spring, but the insects emerge in late autumn or in the following spring.)

*(b) Sexes distinct.*

Andricus amenti.
,, æstivalis.

(These are found on the male catkins, hence both are formed in summer, and both are probably dimorphic.)

The table just given shows at a glance that in no case do the two forms now referred to the same species belong to the same genus under the classification formerly employed. For example, if we take *Spathegaster baccarum*, forming the "currant galls," we shall find it produce the "oak spangles," referred to *Neuroterus lenticularis*. The insects produced from the two forms of galls differ very considerably from one another in structural characters, employing those afforded by the parts about the ovipositor for generic distinctions; so that they are more similar in appearance to allied but truly distinct species than they are to one another.

A still more marked example of great differences between the two generations of the same species is seen if we compare *Trigonaspis megaptera*, reared from the pea-sized galls on the trunks of oaks, with *Biorhiza renum*, reared from the small kidney-shaped galls on the leaf-veins; yet experiment has shown the genetic relationship of the two. *T. megaptera* possesses large wings, while *B. renum* is wingless; the legs are relatively much longer in the former; the form of the body is very different in the two, as is also the colour; and the antennæ are much longer in the former. *T. megaptera* shews both sexes; *B. renum* possesses no males.

To understand the existence of such differences, it is needful for us to bear in mind that the insects in the two generations find the parts of the plant on which they have to operate to deposit their eggs so different in accessibility and in texture, that the instrument suited for the purpose in the one, would fail altogether under the conditions in which it is required by the other. As an example is more easy to follow than the abstract grounds for an assertion, let us look at the conditions for *Spathegaster baccarum* and *Neuroterus lenticularis*. For convenience of reference, they will be referred to as if they were quite distinct species. The former emerges in June, and produces galls on the backs of the leaves after these are fully unfolded; hence it does not require a long ovipositor to reach the proper situation for the egg, and, therefore, for the gall. Its ovipositor is found to be straight for the greater part of its length, and not so long as the abdomen. In *N. lenticularis*, on the contrary, the ovipositor requires to be long, as the insect has to bore in between the scales of the still closed bud, in order to deposit its eggs in the young leaves. This long ovipositor is accordingly found to exist, and to gain the necessary protection it is rolled up so as to be packed away safely between the plates of the abdomen. To allow of its protrusion the hard parts and the muscles alike require to be considerably modified as compared with those of the straight short ovipositor of the *Spathegaster*.

Analogous needs exist, met in the same way, if we compare *Trigonaspis megaptera*, which deposits its eggs in the surface of leaf veins of the opened leaves, with *Biorhiza renum*, which has to push its ovipositor into the closed bud, there to deposit its egg in the growing-point of the bud. It may be observed, though not bearing on the subject immediately under consideration, that the formation of the gall has been found not to begin till the larva emerges from the egg, and that the death of the larva at an early period is usually followed by the mal-development of the gall.

Time will not allow of entering farther, at present, upon the various interesting questions that present themselves in this new field of biological study; nor will it allow me to do so as I had proposed to myself, viz., to give a *resume* of the dimorphism that has been found to exist in the group of gall-making Aphides. This is, however, the less to be regretted that they form only a very small group of gall-makers in Scotland; and very little has been done in working out their occurrence here. M. Lichtenstein has during the past few years been conducting very painstaking researches on these insects in France, and has published several articles on them in the *Entomologist's Monthly Magazine.*

I shall conclude this paper with a list of the Cynipidæ of which the galls have been recorded from Perthshire, in the hope that it may stimulate members of the Society to a search after the forms recorded from other parts of Scotland, but not yet detected in Perthshire. The galls

known from the county, arranging them as in the previous list, are:—

| *Asexual.* | *Sexes distinct.* |
|---|---|
| . . . | Andricus curvator. |
| Dryophanta folii. | . . . |
| ,, divisa. | . . . |
| Neuroterus lenticularis. | Spathegaster baccarum. |
| ,, fumipennis. | . . . |
| ,, numismatis. | Spathegaster vesicatrix. |
| ,, ostreus. | . . |
| . . . | Dryoteras terminalis. |
| Biorhiza renum | Trigonaspis megaptera. |

*Forms not yet shown to be dimorphic.*

Cynips Kollari.
Andricus quadrilineatus.
,, amenti.

From this list it will be seen that there is still work to be done among you in this group of insects.

## *APPENDIX A.*

*Descriptions of forms that have not yet been found in Scotland, but of which the (supposed) other generation is known to be Scottish.*

*Aphilothrix globuli* Hart., is a tiny bud-gall, globular, ending in a blunt cone or wart, diameter about ⅛-inch, surface green, hairless, smooth, but when dried showing a network of low ridges, owing to the fleshy outer wall shrinking on to the hard inner wall. The insects (asexual) are said to emerge from February to April, and the galls are to be found in autumn, but remain a good deal surrounded by the leaf-scales. It is regarded as the asexual form of *Andricus inflator.*

*Andricus gemmatus*, Adler, forms exceedingly small bud-galls (about 1-12th-inch long or less), oval, at first green, then brown, and extremely thin. From its small size this gall must be very difficult to detect. It is formed in summer, and is regarded by Dr Adler as the sexual form alternating with *Aphilothrix corticis*, which is asexual.

*Spathegaster Taschenbergi* Schlecht. is the corresponding form to *Dryophanta folii;* and is also a bud-gall. Several often stand along a young twig, one at each node. They are nearly ovate, with a rounded tip, about ⅛-inch long, and are of a fine velvety violet, due to the presence of a layer of pigment cells and of a fine coat of short pale hairs. The wall is soft, and is eaten by the larva till it becomes exceedingly thin. The galls are to be found in the end of May and in June. The insects (male and female) emerge in June and July.

*Spathegaster similis*, Adler, corresponds to *Dryophanta longiventris.* The galls are much like the preceding; but are smaller and more pointed, with a greenish-gray velvety surface, the hairs on which are longer. They are most commonly found on the adventitious buds near the base of the tree trunks, and appear earlier than the last species.

*Spathegaster aprilina* Gir. has been found near Nottingham, in England. The galls are situated in the midst of bud-scales, more or less surrounded by them; are rounded or oval in form, pea-sized, pale yellowish or greenish spotted with red; and bear a few scattered hairs. They are formed in spring, in a very short time. The insects (male and female) emerge in April or in May, and in a few days the gall shrivels up, and hardly a trace of it is left.

*Neuroterus laeviusculus*, Schenck, forms galls very like those of *N. lenticularis*, but they may be distinguished from the latter by the slightly smaller size, sparser covering of hairs, and saucer-like upturned margains. They occur along with the latter species, but are more often found on the upper surface of the leaf than that species. This gall has been found in various parts of England; and by myself in autumn of this year at Keswick, in Cumberland, hence it might be expected to be found in Scotland apart from the fact that the form *Spathegaster albipes* has been recorded from Glasgow.

*Andricus pilosus*, Adler, is regarded by Dr Adler as the sexual form of *Aphilothrix gemmae.* Its gall seems very closely to resemble the galls of *Andricus amenti* in size and form, and like them is situated on the male inflorescences. Indeed, I cannot point out any character to distinguish the galls from one another, and believe that they may perhaps be the same species. However, Dr Adler's description and figure, though not showing any good distinctive characters, hardly allow of certainty.

## *APPENDIX B.*

*Descriptions of two species omitted. Aphilothrix Clementinæ should have appeared on p.* 125, *before A. callidoma; and Andricus curvator on p.* 123, *before A. marginalis.*

*Aphilothrix Clementinæ* Gir. has been recorded by Mr Cameron *(E.M. Mag. XVI.*, 266, *May* 1880) from Cadder, near Glasgow, "in the middle of October. It was then green, with pink stripes." The gall is spherical, but is slightly conical at the base, and shows a small sharp tip at the apex. It is about the size of a small pea (5 mm. diameter); and the surface bears scattered flattened warts, and is sparsely covered with yellowish-white hairs directed

downwards. The colour is said by Dr Mayr to be brown-yellow, probably at a later stage than that recorded by Mr Cameron. On section there is found to be an outer wall of leathery texture, surrounding a cavity, in which a yellow globular inner gall lies attached at one point to the outer gall, or else entirely free from it. The larva lives in the inner gall. The galls are surrounded at the base by the bud-scales, from which they project more than is usual in bud-galls; but, like the others, they fall to the ground in the end of autumn. They are said to be formed chiefly on the highest twigs of tall oaks. The insects produced are asexual. A few emerge in spring, but most are said not to appear until the next autumn.

*Andricus curvator* Hart. I have already mentioned this species among the makers of bud-galls, under *A. inflator*, whose galls are sometimes simulated by it; but have deferred fuller consideration of its gall, as it is really almost entirely confined to the leaves, though sometimes so near the base of the petiole as actually to include a part of the twig, and thus to seem like a twig-gall. The galls are among the most abundant and best known of our native species. They appear as irregularly-rounded or slightly-lobed masses, ¼-inch or more in diameter, and often fused together to form larger and still more irregular bodies. They are situated usually on the leafstalk, or on the midrib or veins of the leaf, projecting on both surfaces, but frequently the leaf, if attacked in the bud, remains abortive, and the blade is represented only by narrow lobes here and there along the side of the gall. In all cases the galls are the cause of marked deformity of the part affected. The surface is yellowish-green, smooth, and naked. The wall is rather hard and woody, and encloses a large space, in which lies an inner gall, about the size and form of whin seed, either attached to the outer gall at one point, or free in the central cavity. The wall of the inner gall is exceedingly thin (papery), and is brown. When two or more galls are fused together externally the inner galls remain distinct, and show the actual number of galls represented in the common mass. The galls begin to appear as soon as the young leaves burst from the bud. They are fully developed by the beginning of June, and the insects (male and female) emerge in July, in this part of the country.

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20th, 21st, and 22nd December, 1883.

## CONVERSAZIONE

### On the Occasion of the Opening of the Museum to the Public.

For this occasion the Society's Lecture Hall, Library, and Museum were put *en suite* with the New Public Hall and Opera-House and its various rooms, and with the hall and rooms of the Working Boys' and Girls' Religious Society. At seven o'clock on Thursday evening a large audience assembled in the Public Hall, when James Geikie, Esq., LL.D., F.R.S., Professor of Geology in the University of Edinburgh, and late President of the Society, presided, and was accompanied to the platform by the members of Council.

Professor Geikie said—Ladies and gentlemen, when my good friends and former colleagues of the Perthshire Society of Natural Science invited me to open the proceedings on this interesting occasion with a few words, I could not but feel highly honoured. It is with sincere pleasure and much satisfaction that I look back on the time I spent among them—joining in their work—sharing in their anxieties and troubles—helping as best I could in the good fight to attain the object of their desires—and now, those desires having been fully gratified by the accomplishment of the scheme which the late Sir Thomas Moncreiffe had so much at heart—I gladly come to participate in the final triumph. I may confess now—what I never would admit while I was among you—that the scheme proposed by Sir Thomas did at first seem to me somewhat Utopian. And when I reflected that in several larger and more opulent centres, similar well-intentioned schemes had fallen through for want of encouragement, I feared that success was hardly to be expected in such a quiet easy-going place as Perth. By-and-bye, however, when I came to realise the fervour and enthusiasm with which all the members of this Society were embued, I began to hope that something tangible might result from their efforts. They were ambitiously bidding for a gown of gold, and they might at least succeed in getting a sleeve of it. Little did I think that they would eventually obtain the complete garment! And heartily do I now congratulate them, and this city and county, on the success which has crowned their labours. The Museum which is opened to-night, is a credit to all concerned, and may well incite the citizens of

many larger towns to bestir themselves to obtain similar educational institutions. You will remember that during the early stages of the movement for additional Museum accommodation, the selection of a suitable site for the proposed building was for a time much discussed, some holding the view that it would be better to extend the old premises in George Street, as occupied by our friends of the Literary and Antiquarian Society, while others maintained that almost any other site in the city would be better. The latter party, as you all know, carried the public with them, and the present complete and beautifully-situated building is the result. Had the opposing view prevailed, it would have been impossible to have held such a conversazione in connection with the Museum as we are doing to-night. And I have no doubt that the advantages which are so apparent to-night will continue to tell in the future. I spoke a little ago of the Museum being an educational institution, and I should like to point out to you in a very few words what grounds I have for so describing it. This I shall best do by giving a short account of its principal features, and stating as succinctly as I can the object which the Society has had in view in arranging their collection. Now, a Natural History Museum may be general, or it may be local. A general collection will aim at representing fully all the multifarious tribes of plants and animals that clothe and people the earth—all the myriad species of fossil organic remains which have been dug out of the rocks—all the vast variety of minerals and rocks which enter into the solid framework of the earth's crust. As a matter of fact no Museum does contain any such complete collection—the only one in our country which makes any approximation to it being the British Museum. It is, therefore, perfectly obvious that such a general collection is far beyond the resources of any one Society, however wealthy it may be. In a centre like this the most we can hope to do is to form a local collection—that is to say, a collection which shall fully represent the geology, zoology, and botany of the county. For educational purposes I believe such a local collection is of much more value than a highly incomplete general collection, which is the state of most general collections. In a general collection you find that the plants and animals, the minerals and rocks, are classified and arranged according to their mutual affinities, as under orders, families, genera, and species. So that in looking into the cases in such a Museum we may find, lying side by side, species which in Nature never occur together, but often belonging to totally different lands or seas, as the case may be. Unless he be prepared by previous study, the visitor to such a Museum will have only the vaguest and haziest notions as to the geographical distribution of the earth's organic and mineral riches. General collections, in short, are only thoroughly understood and appreciated by professed naturalists, who have already acquired the knowledge to use them in the right way. To a beginner in natural science studies they are rather baffling and confusing, and of much less value than a small well-arranged local collection. For every good local collection must have also its type or index collection—from which the tyro will learn the characters of the various types upon which all the plants and animals of the earth have been framed. Having acquired some knowledge of these types, he then proceeds to study the local collection, and observes to what extent each type is represented; and the knowledge thus acquired will fit him to make the most of any general collection he may afterwards visit. But the tyro will learn much more than this from a local collection. A general Museum will show a beginner in geology, for example, that there are vast numbers of rocks—some of these of igneous origin; some due to the action of water; others composed of mineralised organic matter. But such rock specimens are, as it were, the mere letters of the alphabet of physical geology; and a knowledge of them, although absolutely necessary to a beginner, is, after all, only a means to an end. The chief object which the geologist has in view, is to discover, from a study of rocks as they occur in Nature, through what physical changes the surface of the earth has passed. Now, in a local Museum, the student should find not only a type or index collection of minerals and rocks, but a series of rocks native to the district, arranged in the precise order in which they occur—a classification which should show the relative antiquity of each stratum and rock-mass. Further, he should have the opportunity of inspecting diagrams and maps which indicate clearly the geological structure of the surrounding country. In short, the local collection should be so arranged as to delineate the geological history of the district in as clear and striking a manner as possible. From such a local collection, therefore, the student will obtain an insight into the meaning of geological science, and that is more than he will get in many large and pretentious collections. And as it is with the student of geology, so is it with tyros in zoology and botany. In a good local collection, the index collection will first claim their attention—after which the local collection will give them practical exemplifications of such questions as the geographical distribution of plants and animals, which are among the most interesting in natural science. Indeed, I have no hesitation in saying that a well-arranged and complete local collection will present the most distinct and impressive picture of the

grand scheme of Nature which any kind of Museum can give. Now, it is the hope of this Society to realize in time what we may term a model local collection—a collection which shall be exhaustive of the geology, the zoology, and the botany of this county. Such a scheme cannot, of course, be accomplished all at once;—it will take years of search and labour on the part of the members;—but even already, as you shall see to-night, a good beginning has been made, and no inadequate notion of the natural treasures of this county can be gathered from an inspection of the present collection. Of the educational advantages of such a Museum I need not now speak. I think they are generally recognised by every intelligent and educated man. And I would urge upon every son of Perthshire to do what he can to make this County Museum a success. Let it be borne in mind that the Museum has been constructed solely for the education and entertainment of the community, and that there is no endowment for its support. It is kept up entirely by the Society of Natural Science, and the ability of the Society to do so depends upon the number of its paying members. The Society has fortunately been increasing during the past few years at a gratifying rate, but I feel persuaded that many other natives of Perthshire might be induced to become members if they only realised the good results that are likely to follow from the establishment of this Museum upon a secure basis. To attain this end in a yet more direct manner I would advise that some attempt should be made to collect an endowment fund—which need not be large, but sufficient to pay the current expenses connected with the keeping-up of the establishment. A small sum from every one interested in the educational advancement of his town and county would, in a short time, put the Museum upon an independent footing, and relieve the Society from the present great strain upon its resources. I feel sure that if a scheme of the kind I have suggested were to be brought properly before the public it would meet with gratifying support. Let me add that this suggestion is entirely my own, and has been made without any consultation with my former colleagues in the Society. Although not of Perthshire myself, I yet have the greatest interest in the success of this Museum, and if I, an alien, feel so warmly in the matter, how much warmer must be the feeling amongst yourselves, and why, therefore, should there be any doubt about the success of such an appeal as I have ventured to suggest. But, ladies and gentlemen, I have now detained you long enough, and will conclude my remarks by declaring the Perthshire Museum of Natural History to be now open. And I hope and believe that, under God's good guidance, it will be a blessing to the community—tending as it must do to increase our knowledge of this beautiful part of Scotland, and to heighten our conception of the order and harmony that reign throughout all Nature.

Colonel Drummond Hay of Seggieden said—Ladies and gentlemen, I have to beg of you to join with me in a vote of thanks to Professor Geikie for the very able address he has given us to-night. He has, in the lecture we have just heard, called himself an alien. I can hardly look upon him in that light, because he was for two years President of this Society, and it is owing in a great measure to his energy that the Musenm is in the position in which we find it on this its opening day. I therefore ask you not only to return your thanks to Professor Geikie for the very able address he has given to-night, but also for the assistance we have received from him at various times, and especially during the time he was President of this Society.

Dr F. Buchanan White seconded the motion, and it was carried with acclamation.

LECTURE ON WATER.

At 8.15 as many of the audience as could gain admittance, assembled in the Society's Lecture-Room when,

Mr Samuel Walker, M.A., B.Sc., delivered an interesting lecture on "Water," illustrated by experiments. In the course of his remarks, the lecturer said that if a current of electricity produced by means of a Grove's battery were sent through water, bubbles of gas would be seen rising from the platinum wires immersed in the water, and connected with copper wires from the battery. These gases might be caught in separate tubes and examined, when it would be found that they were hydrogen and oxygen, and that there was exactly twice as much hydrogen as there was oxygen. He farther explained that if a mixtnre of two volumes of hydrogen and one of oxygen were put into a bottle and held to a flame, these gases would combine and form water with violent explosion. That was due to the concussion between the expanded steam issning from the bottle and the air. Hydrogen and oxygen could be obtained from water in an easier way than by means of the electric current. Hydrogen could be got from water by acting upon it with something which would unite with the oxygen and leave the hydrogen; and oxygen could be got by acting on it with something which would take the hydrogen and leave the oxygen. When the metal sodium was put into water it united with the oxygen and set free the hydrogen, which rose in bubbles to the surface.

Hydrogen could also be prepared by passing steam—that was gaseous water—over red hot iron, which united with the oxygen and set free the hydrogen. This the lecturer showed by means of a "Fletcher's furnace," and explained that by a similar apparatus oxygen could be got from water by passing chlorine along with it through a hot tube, when the chlorine united with the hydrogen and set free the oxygen. Speaking of the properties of hydrogen, the lecturer illustrated its lightness by causing a balloon, filled with it, to rise in the air. The inflammability of hydrogen was shown by means of a jet of that gas; and musical sounds were produced by holding tubes of various lengths over the jet—the sound being produced by the explosions which took place in the the tubes. Although hydrogen was a non-supporter of combustion, the lecturer, by various experiments, proved that the terms combustible and non-supporter of combustion were only relative, as oxygen, or ordinary air, could be made to burn in hydrogen. He next spoke of the properties of oxygen, and, by experiments, showed that steel wire, which did not burn at all in air, burned very brilliantly in oxygen. Mr Walker next referred to the impurities in water, which, he said were of three kinds—gaseous, suspended solid matter, and dissolved solid matter. Rain water was the purest kind of water which was found upon the earth; but even rain water was not perfectly pure, for, as it fell, it dissolved the gases in the air—oxygen, hydrogen, carbonic acid, and minute quantities of ammonia. Since, however, hot water dissolved less gas than cold, by heating the water it would give off a quantity of gas. The insipidity of boiled water was caused by the want of dissolved gas. Ammonia, if present, could not be got rid of by boiling, but they possessed a very delicate test for it in a substance called "Nessler's Re-agent," by which as small a quantity as one-two-hundredth of a grain of ammonia could be detected in half-a-pint of water. Water, as it passed over the surface and percolated through the soil, not only carried with it sand and soil, but also dissolved the soluble substances of the soil and rocks. What was dissolved depended entirely upon the kind of rock and soil over which the water flowed. Suspended solid matter, he said, might easily be removed by filtration through sand, charcoal, or porous paper. It was evident, however, that dissolved matter could not thus be separated. In that case they must distil the water—that was, turn it into steam, and then cool the steam, when the solid matter would remain behind. By means of certain "re-agents" the chemist could discover impurities which could scarcely be detected by the ordinary observer. Hard water, he said, was one which did not at once form a lather with soap. If a little soap solution were poured into water which had a small quantity of gypsum or sulphate of lime dissolved in it, a curdy substance was formed in the water, and a lather was not produced until more soap solution was added. The hardness produced by gypsum, and similar substances, was called permanent, because it could not be removed by boiling the water. If carbonic acid were breathed from the lungs through lime-water, the water was turned milky from the production of chalk or carbonate of lime, but if more carbonic acid were passed through, the water would then become clear again. The reason was that water, charged with carbonic acid, would dissolve chalk. If such water were heated, the carbonic acid would be expelled from the water, and the result would be that the milkiness would be reproduced. In the same way water, charged with carbonic acid from the air, or from decaying vegetable matter, if it passed over a chalky region, dissolved the chalk, which was deposited again when the carbonic acid was removed, either when the water simply reached the open air (as in the production of stalactites and stalagmites) or when it was boiled. It was that which caused the furring of kettles and boilers. In Perth the water was very soft, and these effects were not much noticed, but in some places the furring had to be removed periodically by the hammer. Mr Walker then glanced briefly at the subject of crystallization, in which water played an important part. Substances which crystallized, very often contained water, as, for example, ordinary washing soda which, when it was exposed to the air, lost its water, and became a white powder. Different substances crystallized in different forms. Hot water generally dissolved more salt than cold water did, and if a salt were dissolved in hot water, it generally crystallized out when the water cooled. Some substances, however, did not crystallize out if they were kept undisturbed. Mr Walker illustrated this by showing a solution of alum dissolved in boiling water in a flask, which was plugged with cotton wool. The alum did not crystallize out on cooling if the air had not free access to it, but whenever the plug of cotton wool was removed it immediately crystallized to a solid mass.

### LECTURE ON COLOURING MATTERS.

At 9.15 a large and appreciative audience assembled in the Society's Lecture-Room, when

Mr Rufus D. Pullar, F.C.S., gave an interesting address (illustrated with numerous experiments) on colouring matters, with special reference to aniline dyes. All colouring matters, he said, might be divided into two great classes—1st, the natural colouring matters, or those

which were produced through the agency of the natural processes of plant or animal life; and 2nd, the artificial colouring matters, or those which could be produced by various chemical processes without the aid of vital force. Having exhibited numerous samples of natural colouring matters, and of extracts prepared from them, Mr Pullar proceeded to explain more particularly artificial colouring matters, or, as they were commonly called, the coal-tar or aniline colours. It was in the year 1856, he said, that Mr, now Dr Perkin, first introduced his mauve dye—a colour derived from aniline. His discovery resulted from experiments of a purely theoretical nature. His own account of it was interesting. He said—"Chemists have always been desirous of producing natural organic bodies artificially, and have in many instances been successful. It was while trying to solve one of these questions that I discovered the mauve dye. I was endeavouring to convert an artificial base into the natural alkaloid quinine, but my experiment, instead of yielding the colourless quinine, gave a reddish powder. With a desire to understand this peculiar result, a different base of more simple construction—viz., aniline, was selected, and repeating my experiments in this case, I obtained a perfectly black product. This, when purified, and digested with spirits-of-wine, gave the mauve dye." (Mr Pullar here poured a few drops of aniline and hypochlorite of sodium into a vessel containing water, when a splendid violet liquid—the mauve dye—was produced.) Proceeding, Mr Pullar said Mr Perkin was advised to attempt the manufacture of his colouring matter on a large scale, but he did so with considerable fear of the result. He had many difficulties to overcome. At that time, aniline, the source of the mauve, was not an article of commerce, but a mere laboratory preparation. It was known that it could be prepared from nitro-benzol, but then nitro-benzol was a rare product—only obtainable from benzol by treatment with nitric acid, then a difficult and dangerous operation. Benzol itself, however, was readily obtainable from coal tar—an oily black fluid, one of the products of coal, when heated in gas work retorts. It was once a great nuisance to gas manufacturers, but now, he need hardly say, a source of immense profit. It was a mixture of a great number of substances, but he should only trouble them with the names of those which were used as sources of the coal tar colours—namely, benzol, carbolic acid, naphthalin, and anthracen. These, and many other substances, could be separated from coal tar by appropriate means, and each of them was the starting point in the manufacture of a series of colours. In order to manufacture mauve, the clear liquid benzol was first obtained from coal tar by distillation; it was then converted into the oily liquid nitro-benzol, by treatment with nitric acid, and then finally into aniline, from which the mauve dye was obtained, as he had already shown them. He (Mr Pullar) hoped he had made it clear to them how black coal tar came to be the raw material from which, by a series of processes, beautiful colours were obtained. They would, therefore, understand that, by the designation coal tar, it was not meant to imply that colouring matters actually existed in coal tar, and might therefore be extracted from it, but that coal tar was the source of certain products which, when changed by various chemical processes, were capable of yielding coloured derivatives. It was interesting to know the amount of colour obtained thus directly from coal. From 100 lbs. of coal they got a little more than 10 lbs. of coal tar, and from that only about a quarter of an ounce of mauve. Although the amount of colouring matter was very small, it was fortunately very intense, as he would try to show them. (Mr Pullar here took one or two small crystals, of the aniline colour eosine, and dissolving them in a little hot water, mixed them in a large vessel of water, which at once was tinged a deep shade, although the proportion was by weight one part of eosine to a quarter of a million parts of water.) Mr Pullar also showed the intensity of aniline dyes in another way. Taking a bouquet of flowers, which appeared to be white (but which had previously been dusted with various aniline dyes), Mr Pullar damped them with spirits of wine for the purpose of dissolving the colours, when a remarkable effect was produced—the flowers composing the bouquet being instantly changed into brilliant colours. Proceeding, Mr Pullar said he had already told them that aniline colours had superseded the natural colouring matters to a large extent, but there was also another way in which the natural colouring matters had been replaced by the manufactured article. It had been found possible to make, by chemical means, the identical colouring matters contained in those animals and plants which had hitherto been the only source of these products. Many of these processes were at present difficult and expensive, but artificial indigo was beginning to be made on a commercial scale, and for more than 10 years now that artificial alizarine—which was identical with natural alizarine—the colouring matter contained in madder, had been an article of commerce. It could be prepared from the coal tar derivative anthracen, by a series of processes into which they could not now enter, and brought into the market cheaper than the madder plant could be grown and prepared for use. Not onl was it cheaper than natural madder, but it was free from

all the impurities necessarily contained in it, and it had so completely taken the place of natural madder that the cultivation of the latter had almost ceased, and the land formerly used for madder-growing had been thrown free for other purposes. Artificial alizarine, he reminded them, was not, like the aniline dyes, a substitute for natural madder, but it was identical with the colouring matter of madder. One of the most remarkable properties of the natural alizarine contained in madder was its power of forming an insoluble compound with a mordant. (Mr Pullar here took some cloth which had the alumina mordant printed upon it. The pattern was of course as yet invisible, but on boiling the pieces of cloth for a few minutes—one in a solution of madder, and the other in a solution of artificial alizarine —it was seen that the colouring matter combined with the mordant only in the places where it had been printed upon the cloth, thus forming the pattern. It was also observed that both natural madder and artificial alizarine had given identical shades). Madder, or now-a-days artificial alizarine, was perhaps the most important of their dye-stuffs. It was with artificial alizarine that all the familiar Turkey red dyed fabrics were produced. As they were aware Turkey red was a very fast colour, yet still it was not infallible. There were chemical agents which rapidly destroyed it—notably chlorine gas. (This was illustrated by Mr Pullar destroying the colour of a piece of Turkey red cloth by placing it in a jar of chlorine gas.) That same principle, Mr Pullar continued, was made use of in obtaining printed designs upon Turkey red cloth. As the printer could not very well use chlorine gas as such to print with, the manner in which he proceeded was this:—He printed upon the red cloth a pattern with tartaric acid. He then passed it through a solution of chloride of lime. Whenever the parts printed with acid came into contact with the solution, chlorine gas was at once evolved. The red was therefore destroyed just in the printed parts, and a white pattern was the result. If the salt of lead was mixed with the tartaric acid a white discharge was produced as above mentioned; but on passing the cloth through a solution of bichromate of potash the pattern became yellow, owing to the formation of chromate of lead. If a certain proportion of Prussian blue was mixed with tartaric acid and lead salt, and the cloth treated in the same way, a design in three colours—white, yellow, and green—was produced—the green being formed by the mixture of blue and yellow. Mr Pullar, by a series of experiments, showed designs of the foregoing, and concluded by showing a novel design, specially prepared for the occasion—the "Fair Maid of Perth"—in white, yellow, green, and black.

Dr Andrew Wilson, F.L.S., who was to have given an address on the *Challenger* Expedition, illustrated with lime-light views, was unavoidably absent, but the views were exhibited instead by Mr Patrick Geddes, F.R.S.E., Assistant-Professor of Botany in the Edinburgh Botanic Gardens.

Dr F. Buchanan White, F.L.S., explained lime-light exhibitions of the microscopic structure of animals and plants.

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The following exhibitions were on view throughout the buildings:—

In the Working Boys' and Girls' Hall four tables were fitted up with microscopes, divided into various sections, consisting of:—Botany, presided over by Messrs James and Henry Coates; Invertebrates, presided over by Dr Trotter; Geology, with Polariscope, presided over by Messrs Mackie and Macqueen, Perth Academy, and Robertson, Paisley; Diatomaceæ, presided over by Mr S. Keith, Perth; Entomology, presided over by Mr Marshall, Stanley; Micro-Photos, presided over by Mr Magnus Jackson; Pathology, presided over by Dr Ferguson; and Physiology, presided over by Mr James Stewart. On other two tables were exhibited a varied collection of physical and electrical apparatus. On one half of the first table was displayed a collection of various electrical lamps, both arc and incandescent—one of the latter being 1-candle power, and lit by a common battery. These were exhibited by Mr Loring, Manager of the Northern Electric Light Company, Dundee. On the other half of the table was a collection of electro-motors, pumps, &c., and a machine for turning vacuum tubes, which showed the effect of electricity in vacua. On the second table was a varied collection of electrical and other apparatus, including a card with a series of tubes showing the process of the manufacture of thermometers. On another table was a large selection of acoustical and mechanical apparatus, Leyden jars, electro-motors, &c., which was principally exhibited by Mr Campbell, George Street.

Mr Stewart also exhibited sections of human teeth, the circulation of blood in a frog's foot, and microscopic pond life from the North Inch Pond.

In the Society's Library was shown its collection of Perthshire insects and shells.

In the Boys' and Girls' Hall was exhibited a reflecting telescope, sent for exhibition by the Rev. Dr Graham, Errol. The instrument was sent for the purpose of showing how from the simplest and cheapest materials a telescope capable of high astronomical work might be constructed by a person of ordinary mechanical ingenuity. The whole

expense of the materials employed in its construction did not exceed 15s, yet the intsrument carried magnifying powers of 150, 250, and 350 times with perfect distinctness.

In the centre of the Hall, a great variety of telegraph apparatus was exhibited in working order by Mr Macgregor, postmaster, and Mr Gaudie. These consisted of the Morse printing duplex telegraph and sounder, single needle, A B C, Breguet's French alphabetical instrument, electrical repeater for railway signalling, a number of specimens of submarine cables, and other instruments connected with telegraphy. At the end of the table a neat miniature telegraph pole was fixed for carrying the four wires overhead to a distant room, where other sets of the same apparatus were joined up and worked by assistants. Messages were exchanged between the two rooms.

In another part of the hall, a practical exhibition of glass-blowing and engraving was given by Mr Motherwell and Mr Craigie, Glasgow.

On one of the tables was a large collection of colouring matters used in dyeing, chemicals, &c., lent by Mr Rufus D. Pullar. These included an interesting collection from one of the great coal-tar works in Germany, illustrating the manufacture of coal-tar colours and artificial alizarine by samples of all the various raw, intermediate, and finished products. A varied collection of dyewood extracts, and of gums used in printing and finishing, was given by a well-known Glasgow firm; and a Leeds firm also sent a number of samples of orchella lichens and indigoes. Several specimens of woods were also exhibited, including logwood from the Honduras and Jamaica; sunderwood from the East Indies; fustic, from Cuba and Jamaica; camwood and barwood, from the Gaboon River, Africa; and peachwood, campeachy, and limawood, from South America.

Mr Alex. Bain, County Assessor, lent a valuable collection of manuscripts on vellum, rare bindings, and early printed editions of the Scriptures. Among others, there were a 13th century copy of the Bible, beautifully written on 500 leaves of the thinnest vellum, and a Book of Hours, written on vellum, with 14 miniatures painted in gold and colours—the manuscript being as fresh as when it left the illuminator's hands 400 years ago. On a table adjoining this was a collection of specimens illustrative of the manufacture of pottery.

In a room adjoining the Working Boys' and Girls' Hall was a collection of 25 models working by electricity and steam, consisting of high-pressure beam-engines (with boiler complete) working a powerloom for jute weaving; horizontal condensing engines, fitted with reversing gear; two small beam engines (one standing in 2 inches by 3, made by Mr Chrystal, St John's Foundry, Perth); and a small locomotive, with reversing gear. These were all worked by steam. Those worked by electricity consisted of an electro-motor engine and an electric pump engine. This department was under the charge of Mr A. E. Pullar. In three rooms—one each in the Museum, the Boys' and Girls' Hall, and the Gymnasium—were shown examples of telephonic exchange, fitted up by Messrs Westwood Sons & Miller, bellhangers, Princes Street. The phonograph was also exhibited in one of the rooms of the Boys' and Girls' Hall, under the charge of Mr Mathieson, Dundee.

The Museum was lit up with thirty 20-candle-power incandescent lamps, which gave a clear and cool light; and the lobby connecting the Boys' and Girls' Hall with the Society's Rooms was also lit up with incandescent lamps. Outside the building, at the corner of Canal Street and Tay Street, was one of Siemens' arc lamps, of 3000 candle-power.

Mr George Grieve and Mr W. Ellison had charge of the lime-light exhibitions; Mr S. T. Ellison, of the electric light; and Mr Campbell, of the microscopes and physical apparatus.

The programmes of Friday and Saturday evenings were similar to that of Thursday, with the exception that in place of the opening address by Professor Geikie, addresses were given by Mr F. W. Young, F.C.S., F.R.S.E., Dundee, on the Spectroscope and its uses (illustrated by experiments), and by Mr Patrick Geddes, on the Study of Biology.

During each evening Messrs Pullars' reed band played selections at intervals.

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## January 10th, 1884.

S. T. Ellison, Esq., Vice-President, in the Chair.

### NEW MEMBERS.

The following were elected:—Miss Phillips, Tay Street; Mr John Wilson, High Street; Mr R. P. Ramage, British Linen Bank; Mr Alexander Drysdale, General Prison; and Colonel Campbell, Governor of the General Prison.

The following were nominated for election at next meeting:—Dean of Guild M'Arthur; Mr James Ogilvie, Blairgowrie; Mr J. Thomson, Dundee; Mr D. J. Keay, Perth; Mr J. A. Robertson, Perth; Mr D. N. Shaw; Mr D.

Forbes; Dr Graham ; Mr D. Wylie ; Mr A. J. Wilson, Clydesdale Bank ; Mr J. W. Fehrenbach, Dunkeld ; Mr and Mrs P. Smith, Marshall Place; Mr and Mrs D. Soutar; Mr A. Syme, Muirton Bank; Mr Wm. Garvie, Balhousie; Mr W. Miller, George Street ; Mr A. Fraser ; Mr James Morrison ; Mr J. W. Jameson, Bank of Scotland ; and Mr Charles Law, Princes Street.

DONATIONS.

The following were intimated :—

*1. To the Perthshire Collection—*

From the Duke of Athole, per Mr John M'Gregor, head-forester—Specimens of the timber of 17 indigenous trees of Perthshire. These include longitudinal sections showing the wood and the bark, and cross sections, making in all 51 specimens, which, when dried and polished, will form, with the specimens already in the Museum, an almost complete collection of the native woods of the county.

From Dr Trotter, Perth—Specimens of lead ore and silver-lead ore, from Tyndrum, Perthshire.

From Mr Gow, Perth—Specimens of barytes, or heavy spar, from Kinnoull Hill.

From Mr Chrystal, Perth—Piece of wood found 22 feet from the surface in sinking a well in Canal Street Brewery. (This is evidently from the buried forest or peat-bed, which stretches from Perth to Dundee.)

From Messrs Small & Co., Pitfour Brickworks—Nodules of clay, some of them attached to a glaciated stone, found 15 feet from the surface of the ground, at Pitfour Brickworks.

From Messrs M'Currach & Sons, Victoria Street—Two specimens of building stone from Letham Quarry, near Perth. (These are freestone or old red sandstone. Specimens of stones from any quarry in Perthshire are much desired. If freestone, specimens should be selected to show the various qualities. If whinstone, specimens should be taken from the centre and from the sides of the quarry.)

From Mr Stewart, gamekeeper, Logiealmond — Two mountain hares, showing the transition from the summer to the winter fur.

From Mr John Stewart, Princes Street--Fish (haddock, whiting, and sprat), from the mouth of the Tay.

From Dr Buchanan White, F.L.S.—Father-lasher, from the mouth of the Tay.

From Mr P. D. Malloch—Carp from the Tay. (Specimens of all kinds of fish are much desired, both from the estuary of the Tay, and also from every river and loch. It is very desirable that the common trout of every stream and lake should be represented in the Museum, but it is only by the assistance of anglers that this can be done. It should be known that it is not necessary that the specimens should be other than the usual size.)

Plants from Mr C. M'Intosh, Inver ; Rev. E. W. Linton, Norfolk ; Mr Mennell, Croydon ; Mr Miller, Croydon; and a large number from Colonel Drummond Hay.

From Dr Buchanan White and Mr S. T. Ellison—Perthshire insects.

From Mr Scott, gamekeeper, Methven—Two squirrels and a stoat.

*2. To the Index Collection—*

From Professor Allen Harker, Cirencester—Nine jars of anatomical preparations illustrating the structure of animals.

From Professor Trail, Aberdeen—Skeleton leaves.

From Mr C. S. Whittet, Mill Street—Various specimens.

From Mr R. Brown, R.N., Barnhill—Various botanical and zoological specimens.

PROPOSED FEDERATION OF SCIENTIFIC SOCIETIES OF THE EAST OF SCOTLAND.

Dr BUCHANAN WHITE reported that Mr Robert Pullar and he had met the two delegates—Mr F. W. Young and Mr J. Martin White—appointed by the Dundee Naturalists' Society, and, after preparing the draft of a constitution for the proposed Union of Societies, had arranged that delegates from the various Societies should be invited to meet at Perth and discuss the matter, with powers to establish the union. It had since been suggested by the Dundee delegates that Saturday, 9th February, would be a suitable day for the meeting. Dr Buchanan White asked that Mr Pullar and he should be re-appointed the delegates of the Society, and that the Council should be instructed to examine the draft constitution, and to make arrangements for the meeting.

Dr White's suggestion was unanimously agreed to.

Dr Buchanan White, F.L.S., read the following notes :—

1. *On a Hedgehog's Nest.*—In Bell's *British Quadrupeds,* it is stated that the hedgehog makes the nest in which it passes the winter entirely of withered leaves, and probably this is usually the case, but to show that it is not invariably so is the purport of the present note. When trimming away the withered vegetation in my rock garden lately, my attention was attracted by a bundle of grass (where no grass ought to have been) half-buried in the earth, under a small bush on a bank. On looking at it more closely I perceived that the straws of grass had a somewhat

definite arrangement, being so curved as to form a ball. Suspecting what it was, I made a slight opening in the mass, and found a hedgehog inside, which I covered up again and left. Though there were plenty of withered leaves lying about, the animal had rejected most of them, and taken the trouble to bring the grass from some yards distant. The grass may have been lying cut, but I am inclined to think that the hedgehog must have pulled it itself. From the position of the nest withered leaves of trees would have probably been blown away, and left the creature exposed, while the long grass stems formed a much more compact and less easily destroyed nest.

2. *Seasonal Phenomena.*—In former years I have brought before the notice of the Society, on several occasions, certain seasonal phenomena, such as the dates of the flowering of plants. These have some interest, as showing either the character of the season, or the precocity of certain plants. From the absence of any long-continued and severe frost this winter, many more plants are in flower in the open air than would have otherwise been, and I have brought a few to lay before you. Some of them have just come into flower, but many have not been out of flower since autumn. The following is a list of those I have seen in my garden to-day, most of which I now show you:—1. Daisy (The daisy has been adopted by the Society as its badge, but I do not think that the reasons why this plant has been selected have ever been stated. In the first place, the daisy is an illustration of the fact that "Union is Strength," for, being of the order Compositæ, its flowers are collected into a head, the different parts of which have different functions, but all tending to the common welfare; in the second place, the daisy is everywhere, and so the Society should be; in the third place, it is always growing and always flowering—that is, accomplishing its work and never idle—and this is what the Society should also be; lastly, though it is but a humble plant, and one of those common things which are too often despised because they are "common," yet it shows, by its structure and colours, the wonderful beauty—whether of colour, of form, or of adaptation—that pervades all Nature.) 2. Snowdrop (just coming into flower); 3. Buttercup *(Ranunculus repens)*; 4. Christmas Rose *(Helleborus niger)*; 5. Pansy; 6. Stocks, of various kinds; 7. Roses; 8. *Potentilla Fragariastrum*; 9. *Potentilla alba*; 10. Chickweed; 11. Groundsel; 12. *Euphorbia Peplus*; 13. Moon Daisy *(Chrysanthemum leucanthemum)*; 14. Honeysuckle; 15. Polyanthus (several kinds); 16. *Erodium Manescavi*; 17. *Veronica rupestris*; 18. *Veronica spicata*; 19. *Kerria japonica*; 20. Prickly Comfrey *(Symphytum asperrimum)*; 21. *Lamium maculatum* (two varieties); 22. *Polygala Chamæbuxus*; 23. Sweet Violet; 24. *Erysimum pulchellum*; 25. *Androsace carnea*; 26. *Potentilla argentea*; 27. *Arabis procurrens*; 28. *Poa annua*; 29. *Aubretia purpurea*.

The following paper was read:—

"*The Life History of a Garden Snail.*" By Mr H. Coates, F.R.P.S.

In a former paper, giving notes on the Land and Fresh-Water Shells of Perthshire, I pointed out that these represent two well-defined classes of the sub-kingdom Mollusca,—the one having, amongst other distinctions, a shell consisting of two pieces or valves; and the other, either a shell consisting of a single valve or no distinct shell at all. The characters of the former, the Lamellibranchiata, I have described in a paper on the pearl-mussel of the Tay *(Unio margaritiferus)*, which was selected as a type of the class. With the other, or Gasteropoda, I intend to deal under the present heading.

In the first place, it is necessary to remark that land and fresh-water snails do not by any means constitute the whole, or even the majority, of this important class, which comprises as well what have sometimes been called "the snails and slugs of the sea." Instead of describing in general terms the structure and habits of the Gasteropoda, let me select as a type what is known in England as the common garden snail *(Helix aspersa)*, —a snail which, however, is fortunately not quite so common in Scotch gardens as in English. If we examine this species, and trace its history, we shall perhaps have gained a clearer idea of the characters of the class than could have been conveyed by a a more general description.

I will ask you to accompany me, in imagination, on a snail-hunting ramble, say towards the end of August, and try what we can observe of the life-history of these creatures. Leaving the dusty highway, we will search out some unfrequented spot, such as the waste corners of fields, where weeds luxuriate; or, better still, a rocky and shaded glen. Lifting carefully a patch of the damp moss, we may find, a little way under the surface of the loose soil, a group of small round bodies of a creamy white. These are the eggs of the snail, laid carefully where they will be moist, and undisturbed. They measure from the tenth to the eighth of an inch in diameter, and may number as many as 100, or 110. Sometimes they are glued together in clusters, sometimes separate. The eggs of some of the African cousins of our snail are magnificent objects compared to these little white balls, being half-an-inch long, and enclosed in a hardened shell. If we replace the moss, and visit the spot again fifteen or twenty days later, we shall find, in place of the eggs, a group of tiny mollusks, each possessing, though newly hatched, a transparent spiral shell, complete in form, but so fragile that the slightest pressure will crush it. The young snails spend their early days chiefly in their place of concealment, only coming out for a little while on damp evenings, and during this time they grow very rapidly. The shell increases in size by continual additions to the edge of the lip, and in thickness by the addition of layers to the inner surface.

By the end of October, those members of the brood which have not fallen a prey to the attacks of birds and other enemies, will have attained the size of hazel nuts. If we take up one to examine it, however, we must remember that the strengthening of the shell has not kept pace with its growth, and that the least rough handling will break it. The mouths of young shells are particularly delicate, for it is not until they are full-grown that the strong rib is added which gives to this part the strength which, in the rest of the shell, is supplied by its spherical form.

On the approach of frost, the snail—which is sensitive to both extremes of temperature—prepares for its winter seclusion. It

retires into some sheltered nook, such as the crevice of an old wall, the hollow of a decayed tree, or the cleft of a rock. Failing any such natural hiding-place, it will bury itself a little way under the surface of the soft soil,—its head generally being uppermost. Frequently a number of snails group themselves together during hybernatiou, adhering to each other's shells. Having selected its retreat, its next care is to close up the mouth of its shell for protection from cold and from the dryness of the air. This it does by constructing across the opening a horny barrier, or diaphragm, as it is called, formed of hardened mucus. It theu retires to the furthest extent into its shell, and there constructs a second and similar barrier. In each of these diaphragms a small aperture is left to admit of respiration. The Roman snail of Kent and Surrey *(Helix pomatia)* forms a solid diaphragm of shelly material, which may be found in spring after the suail emerges from its winter quarters. During hybernation no growth takes place, and pulsation of the heart is said also to cease. The ouly vital process which appears to be carried on is a slow respiration. It frequently happens that the snail does not survive its winter privations, as in spring groups of empty shells may sometimes be found, glued together, as they were by their inmates, who have not had strength to liberate themselves from their voluntary prisons. But if it does survive, then, with the first return of warmth, it breaks open its double doors by dissolving their edges in a fresh secretion of mucus. Frequently, hollow impressions may be observed on limestone rocks where snails are in the habit of hybernating, produced either by the wearing action of the foot, or rasped by the tongue to obtaiu lime for the formation of the shell.

During the eusuing spring and summer the snail will grow rapidly, and by the following autumn will have attained its full size. Should the summer be dry aud hot, it will hide itself for some days or weeks in the same way that it does during the severity of winter, but with this difference, that the head will be downmost. During such an aestivation, the vital functions are not so completely suspended as they are in hybernation, and growth does not cease. By the eud of summer the snail will be busy depositing its eggs in a secure hiding-place, and this brings us to the close of a cycle of snail existence. Very little is known as to the usual duration of a snail's life under natural conditions, but it is thought probable that the majority do not survive their second hybernation. In captivity, however, they have frequently been known to live six or eight years; and there are instauces on record of even greater longevity. Their powers of enduring privation are very great. Thus, a specimen of an African snail, *Helix desertorum,* was fixed to a tablet in the British Museum in mistake for an empty shell iu March, 1846. In March, 1850, it softened the glue with which it was fixed, and crawled off its card after a fast of four years. This fact is vouched for by Dr Woodward, the Assistant-Curator of the Museum, in his *Manual of the Mollusca.*

Such is a very brief *resume* of sóme of the events which mark a snail's career. Let us now take up a mature specimeu, such as we may find on some parts of Kinnoull Hill, aud make a closer nspection of the creature itself. Perhaps we shall find in doing so that it has a more highly-organised body than we gave it credit for. If we place our specimen, say, on a large leaf, and wait until it has recovered from its alarm on being disturbed we shall presently see a shapeless grey mass emerging from the shell, and from the centre of this mass the head is first cautiously protruded; and then from the latter the horns gradually unfold themselves. While it is crawling slowly away, we may note that the part of the body which is protruded from the shell consists, broadly speaking, of three principal parts—first, the thick fleshy disc on which it crawls, called the "foot;" second, the pliable membrane which lines the shell, and forms a kind of hood over the head, called the "mautle;" and third, the head itself. Besides these, there is the part of the animal remaining within the shell, which comprises chiefly the digestive system and other vital organs.

The muscular system is of a highly-developed type, and preseuts points of special interest; but iu studying these it is necessary to bear iu mind that the muscles, with the exception of those connected specially with the shell, are attached to the inner surface of a pliable integument or skin. In this they present a marked contrast, on the oue hand, to those of such animals as insects, crustaceans, &c., whose bodies are enveloped in a horny or shelly covering; and, on the other, to those of vertebrate animals, whose muscles have their attachment in a hard internal framework. The shell of the snail, therefore, as we shall see more fully afterwards, partakes more of the character of a protection than of a true exo-skeleton.

The structure of the foot, aud the way iu which locomotiou is effected, form a curious physiological study. The action of the muscles can best be seen by allowing the snail to crawl along a pane of glass, so that we can watch the surface of the foot from beneath. A continual series of curved waves will appear to pass from front to back with a perfectly rythmical motion, their greatest intensity being in the central line. This appearance is produced by the rapid contraction aud expausion of each set of muscles in succession; so that if the actual rate of progression is slow, it is the result of a large amount of muscular actiou on a minute scale. On a dry summer evening it has often been observed that a distinct musical souud is produced by a snail crawling on a window-pane, this proviug how perfectly rythmical the wave-motion is.

Coming now to the head, the chief points of interest are the structure of the tentacles or "horns," and the arrangement of the teeth. The former are remarkable for the mechanism by which the snail is able to put them out or withdraw them at will. This is done, not by drawing the entire tentacle iuto a receptacle, but by folding it in upon itself in precisely the same way that the finger of a glove is drawn iu upon itself when it is turned inside out. Each tentacle consists of a hollow tube with muscular walls arranged in a series of rings, and with muscles leading from its extremity into the head. It is by the contraction of these latter muscles that the tentacle is withdrawn, while its protrusion is effected by the alternate expansion of the muscular rings. It may occur to some of you to wonder what happens, during this process, to the delicate nerves contained within the tentacle, which cannot be stretched beyond their normal limit.

This is provided for by allowing them to coil upon themselves in the form of a spiral spring.

The structure of the mouth next claims our attention, and when we have examined it we shall find that it is precisely such as to meet the requirements of a creature feeding on soft vegetable tissues. The upper part is provided with a hard horny jaw, presenting a curved and indented cutting edge. On the floor of the mouth is a long ribbon-like tongue, whose surface is entirely studded with minute flinty teeth arranged in the most beautifully symmetrical manner. This rasp-like tongue works backwards and forwards against the edge of the jaw, and draws in young leaves and shoots, which are cut off by the latter. These ribbon-tongues, or odontophores, are most interesting objects to study under the microscope, and the manner in which the teeth are arranged is characteristic in each species. They are easily obtained by carefully dissecting the head after the snail has been killed. In the garden-snail the number of these teeth is 14,175, arranged in 135 rows of 105 each. It is evident that with continual wear and tear these teeth must get broken and blunted, but provision is made for this by the tongue being constantly renewed from behind; so that while the front portion is being worn away, a freshly-armed portion is coming forward to take its place.

The chief interest attaching to the mantle is that it is the part of the animal which is concerned in the work of building up and ornamenting the shell. While it envelopes the animal, it lines the shell, and corresponds with it in shape. Its margin, where it encircles the head with a kind of collar, is considerably thickened, and it is this portion which is chiefly employed in adding to the edge of the shell; while the whole surface is engaged in forming the inner lining. The colour and markings of the shell are the result of pigment-glands with which the mantle is provided. There are many interesting questions connected with the structure of shells, their mode of formation, analogies, &c., which it would carry me much beyond the limits of the present paper to enter into. For the present, therefore, I will only ask you to bear in mind that the shell is not to be looked upon as a structure distinct from the rest of the animal, but simply as a hardened or calcified portion of the mantle, and that its primary use is to serve as a protection to the heart and lungs.

The nervous system is characteristic of the sub-kingdom, and differs from that of both higher and lower groups in being entirely unsymmetrical. It may be broadly described as consisting of three centres, or ganglia, connected by nerve-fibres, and giving off nerves to all parts of the body. The functions with which these centres are severally connected will be seen by the positions which they occupy, the first and most important being in the head; the second in the foot; and the third in close proximity to the heart and lungs. Of the organs of sense, the eyes are situated at the extremities of the two longer tentacles in the form of small bulbs. It is probable that they are capable of receiving impressions of light, but not of form. The organs of hearing—we can hardly call them "ears"—are situated at the base of the tentacles, and consist of little vesicles or sacs filled with fluid, in which float particles of lime known as "otoliths." Supposed organs of smell have been detected, but the presence of the senses of smell and taste can with greater probability be inferred from the selection evinced by the snail in the choice of its food, and from the considerable distances it has been known to travel in quest of a savoury morsel. The entire skin constitutes the seat of the sense of touch, but the four tentacles serve especially as "feelers," and are constantly waved to and fro to guard against the approach of danger.

The remaining details of structure are more of anatomical than of general interest, and may be dismissed in a few sentences. The digestive system occupies the greater portion of that part of the animal which is contained within the inner whorls of the shell, and is remarkable for the large development of the liver. The heart consists of a single auricle and ventricle: the former to receive the purified blood from the lungs, and the latter to propel it throughout the system. The blood of the snail is a clear colourless fluid, and is conveyed directly from the system back to the lungs without the intervention of the heart. The lungs are constructed upon the simplest type, consisting of a single pulmonary chamber, or cavity, formed by a fold of the mantle. The inner surface of this chamber is lined with a network of minute blood-vessels, in which the blood is purified and oxygenated by the air introduced into the chamber in the process of breathing. If we watch a snail as it crawls along, we may observe a small round opening at the right side of the neck, which slowly contracts and expands. This is the breathing aperture, and leads directly into the breathing chamber. The alternate expansion and contraction of this chamber is effected by the rise and fall of its muscular floor.

Having concluded our hasty dissection and examination of the snail, we will return to the woods, and try what we can learn further of its habits. To do this to advantage, we must set out in the early morning, or after sundown in the evening; and, if the weather is damp, so much the better for our purpose. From this circumstance in itself, we may learn an important fact in snail economy, namely, that these creatures invariably shrink from the sun's rays. Their bodies must constantly be bathed in the slime or mucus which is poured out from glands with which the skin is copiously provided, and exposure to the sun would soon dry up and harden this secretion. During the heat of the day, therefore, in dry weather, the snail hides under stones, moss, or leaves, or anything that will afford it shelter, and only comes out in search of food after the dew has moistened every leaf and stone, and prepared a path over which it can crawl without injury to its slimy consitution. For the same reason, autumn, when the fields and woods are moist and the soil rich with decaying vegetable matter, and before the frost has yet hardened the ground, is the season in which the snail-world revels.

The slow rate of progression of the snail is proverbial, and is to be accounted for, as already pointed out, by the laborious mode in which locomotion is effected. It first occurred to an American naturalist, Mr Thompson, to calculate what this rate actually is, and the conclusion he arrived at was that 16 days and 14 hours is the time that a moderately expeditious snail would take to accomplish a mile! I cannot vouch for the accu-

racy of this statement, nor say whether snails in the New World have acquired more energetic habits than their cousins on this side of the Atlantic.

Snails, as already pointed out, are chiefly herbivorous, living on leaves and young shoots, as well as decaying vegetable matter. They will not refuse small particles of animal food, however; and have been observed to pierce the eggs of small birds in deserted nests, in order to feast upon the contents. They have even been charged with the crime of cannibalism; and Prof. Lister records an instance in which he put a garden snail and a black slug *(Arion ator)* in the same box, and on the following day found the latter killed and half-eaten. So long as vegetable food is abundant, however, it is probable that it is only the gardener who has to complain of the snail's depredations. On the other hand, the catalogue of the snail's enemies is a long one. Hedgehogs, rats, thrushes, ducks, snakes, toads, and foxes attack him from without, while insect parasites prey upon him from within, and all in addition to the warfare waged against him by man. Perhaps his most persistent enemy is the thrush, whose *modus operandi* is as ingenious as it is cold-blooded. The unsuspecting snail is suddenly seized up and carried to a chosen place of execution, namely, a large block of stone. On this its shell, which constitutes its only means of defence, is smashed, either by being dropped from a height or by deliberate blows. Such stones may frequently be found surrounded by the debris of the slaughter. One insect parasite *(Cochleoclonus vorax)* effectually expels the snail from its house, of which it takes possession for the use of its own family. It lays its eggs in the body of the snail, and when these are hatched the larvæ proceed to eat up their host by slow degrees. By the time this is accomplished, the intruders pass into the crysalis stage, and in this form esconce themselves safely in the innermost recess of the spire of the empty shell.

I may conclude this sketch by mentioning some of the ways in which the snail is directly of service to man. Doubtless it has primarily an important part to play in the economy of Nature, had we but another Darwin to point out what that part is, as has been done with such marvellous ingenuity in the case of its humbler brother, the earth-worm. It is of direct use, first, as an article of food. In some parts of Southern Europe snails form a large proportion of the diet of the peasants, and, prepared in certain ways, are esteemed a great delicacy. Seven or eight thousand snails are thought a necessary part of the provisioning of a vessel starting on a voyage from Bordeaux. They are purchased at the rate of 25 centimes, or 2½d, per 100. Once a-year, on Ash Wednesday, a snail feast is held throughout France, when immense numbers are consumed. The same custom was prevalent in our own country in olden times, and indeed still lingers in some parts of the north of England, where the working classes go out on the Sunday preceding Ash Wednesday to gather the snails for the feast. In the south of England the snail is of service to the farmer, where the value of South Down mutton is greatly enhanced by the quantities of snails consumed by the sheep. Medical science is indebted to the snail for a preparation known as helicine, extracted from the slime; while from the same secretion is obtained a substance used in bleaching wax, and also an ingredient in some kinds of cement.

Such are some of the facts to be gleaned from the life-history of a common snail. I trust I have succeeded in showing that it is a history which will well reward a little careful study, and that this creature, which is commonly looked upon only with feelings of disgust, is endowed with an organisation which may well excite the interest and admiration of the lover of Nature.

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## February 7th, 1884.

Mr S. T. Ellison, Vice-President, in the Chair.

### NEW MEMBERS.

The following were elected:—Mr J. M'Arthur, Lord Dean of Guild; Mr James Ogilvie, Blairgowrie; Mr J. Thomson, Dundee; Mr D. J. Keay, Perth; Mr J. A. Robertson, Perth; Mr D. N. Shaw; Mr D. Forbes; Dr Graham; Mr D. Wylie; Mr A. J. Wilson, Clydesdale Bank; Mr J. W. Fehrenbach, Dunkeld; Mr and Mrs P. Smith, Marshall Place; Mr and Mrs D. Soutar; Mr A. Syme, Muirton Bank; Mr William Garvie, Balhousie; Mr W. Miller, George Street; Mr A. Fraser; Mr James Morrison; Mr J. W. Jameson, Bank of Scotland; and Mr Charles Law, Princes Street.

The following were nominated for election at next meeting:—As ordinary members—Mr W. Westwood, Princes Street; and the Rev. A. Campbell, Free Church, Errol.

As corresponding member—Mr E. P. Ramsay, F.L.S., Curator of the Australian Museum, Sydney.

As associates—Mr Laidlaw, gamekeeper, Castle Menzies; and Mr M'Donald, gamekeeper, Rannoch Lodge, in acknowledgement of their many contributions to the Perthshire Collection.

### NOMINATION OF OFFICE-BEARERS.

The following were recommended by the Council for election as office-bearers for the ensuing year:—President, Dr Buchanan White, F.L.S.; Vice-Presidents, Captain D. M. Smythe, yr. of Methven; Mr S. T. Ellison, Mr John Macgregor, and Mr James Stewart; Secretary, Mr John Young, C.E.; Curator, Colonel Drummond Hay, C.M.Z.S., of Seggieden; Treasurer, Mr John Stewart; Librarian, Mr James Coates; Editor, Mr Henry Coates; and Members of Council, Messrs A. Sturrock, R. D. Pullar, and Dr Trotter.

## DONATIONS.

The following were announced :—

*Perthshire Collection.*—From Lady Willoughby de Eresby—A very fine red deer hind. A stag has also been promised by the same donor, and may be expected soon. These will be valuable additions to the Perthshire collection. From Colonel Drummond Hay—Nests of blackbird and thrush; and stands for birds. From Mr George Alexander, 3 St Paul's Square—Eggs of sedge warbler, garden warbler, and white-throat. [As the time for birds' nests and eggs is now coming on, it may be mentioned that Perthshire specimens of both nests and eggs of many birds are still required. Though the Society desires to deprecate the practice, which is too prevalent, of taking the nests and eggs of birds with no special object in view, yet, since much instruction may be gained from a collection of nests and eggs, it is necessary that such a collection be formed. The lessons conveyed by it will, it is hoped, tend to diminish the indiscriminate robbing of birds' nests.] From Mr W. Herd, Scoonieburn—Specimens of some Perthshire woods, and of woods injured by insects. From Mr David Martin, Canal Street Brewery—Specimens of wood and stone from the buried peat-bed, alluded to in the last report of donations. From Mr John Knox, Forfar—Specimen of *Carex ustulata.* From Mr Barlas, Pitcaithly Quarry—Specimens of building stone from that quarry. From Mr John Moir, builder—Three samples of stone from Huntingtower Quarries. [The collection of building stones, when completed, will, it is hoped, be found of considerable utility, as it will enable persons who think of building houses to see the quality and colours of the local building stones.] From Mr A. Sturrock, Rattray—Rare Perthshire plants. From Mr James Stewart — Specimen of hair eel *(Gordius aquaticus).* From Dr Trotter, Perth—Fossil diatoms from the brick clay bed at Tullylumb, and recent diatoms from the Tay at the North Inch; and specimen of mica schist, with garnets, from the boulder clay, Stanley. From Mr Thomas Peddie, Union Street, Perth—Specimen of lead ore from quarry at Taymouth. From Rev. Dr Milroy—Specimens of boulder clay, and stones from the boulder clay, at Moneydie.

*Index Collection.*—From Mr E. P. Ramsay, F.L.S., Curator of the Australian Museum, Sydney, New South Wales—Skeleton and stuffed specimen of the Duck-billed Platypus, and other valuable specimens. From Mr D. M'Donald, Perth—Quartz containing gold, and other specimens, from Australia. From Mr David Sharp, 216 High Street—A large Echinus or Sea-urchin. From Mr George Alexander, 3 St Paul's Square—A pipe fish. From Mr R. P. Blair, chemist—"Guinea Worm" and other specimens. From Mr H. Wilkie, Perth—Photograph of a fossil fish (from Clashbennie Quarry, near Glencarse), now in the British Museum; and various pamphlets. From Dr Baird—Specimens of india-rubber in various states.

## EXHIBITIONS.

Dr Buchanan White exhibited the specimen of *Carex ustulata* which had been presented to the Herbarium by Mr John Knox, Forfar, and made the following remarks:—When recording, amongst the donations, this gift by Mr Knox, I purposely made no comments, as the specimen is worthy of a special notice. We have here a Perthshire plant, which is possessed of considerable interest in several respects. First, in that it is one of George Don's discoveries; second, in that the specimen was gathered by him; and third, in that no one but Don has gathered the plant in Britain. Some of us, doubtless, remember that Mr Knox once gave us an interesting paper on Don's life and work, which was subsequently published in *The Scottish Naturalist.* Don, who flourished at the end of last century and the beginning of this, was a man whose love of botany exceeded his worldly wisdom, and who was consequently not so successful in the various occupations he followed as he deserved to be. He did much in the way of exploring the botanical riches of the Scottish hills, and added many species to our lists. Unfortunately, he sometimes sent out garden specimens of the plants that he thought were the same as he had found on the hills, but which were really different species, and hence, those of his discoveries which have not been verified by others, are repudiated by many botanists of the present day. Amongst these is the plant now before us, which Hooker and others reject, but which Babington and Boswell accept. Dr Boswell, in his edition of English Botany, has remarked that Don has never been accused of sending out foreign specimens of the plants he said he had discovered in Scotland, and that the specimen of *Carex ustulata,* which he (Dr Boswell) had seen was evidently a wild specimen, and still had on its roots bits of micaceous soil. Our specimen, like Dr Boswell's, has all the aspect of a wild specimen, and bears on its roots abundant traces of a micaceous soil. Now, Don says that he discovered this plant on Ben Lawers, and as herbarium specimens of plants from that mountain are usually characterised by having on their roots soil exactly similar in appearance to that which this specimen bears, I have little doubt but that it came from Ben Lawers. No one but Don has found it there, and though it has not been rediscovered, it perhaps is only waiting for some energetic member of our Society to find it. Botanists usually search only on certain parts of the hill, and it is just possible that Don found it on some outlying portion which botanists rarely visit. The history of this specimen is as follows :—Don made up a volume of grasses, sedges, and similar plants, to which he attached the names, but seldom mentioned the locality. In this volume this specimen of *Carex ustulata* had attached to it, in Don's writing, "I discovered this plant on Ben Lawers in 1810." Don's effects were sold in 1814, and the volume was bought by Mr Blackadder, land-surveyor, Glamis, after whose death it came into the possession of his nephew,

from whom Mr Knox bought it. Mr Knox kindly sent the volume for my inspection a short time ago; and, though naturally reluctant to part with any of the contents of the interesting volume, he has consented to present this specimen of *Carex ustulata* to our Herbarium. The very complimentary terms in which he has made the gift are too personal (to me) for me to repeat. As, however, his letter is an item in the history of the specimen, I have attached it to the same sheet. I think a very hearty vote of thanks is due to Mr Knox for his gift, especially when we consider that, as specimens cannot be purchased now, it forms an invaluable acquisition to our collection. I take this opportunity of exhibiting another of Don's Perthshire discoveries, a specimen of which is in the volume mentioned above, and which I now show you. This is a grass which Don found on Ben Lawers, and which he thought was an undescribed species, and called *Triticum alpinum*. Visitors to Ben Lawers seem generally to have overlooked it, but that it is still there is proved by a specimen I have seen, and which was gathered by Mr Cosmo Melvill in 1878. Mr Melvill had not, however, seen Don's specimens, and did not identify it as the same plant. This I was enabled to do when Mr Knox sent me Don's volume. The plant, however, is not a distinct species, but a variety of one of the lowland grasses. Most botanists, following Mitten, consider it to be a variety of *Triticum caninum*—the var. *biflorum* Mitten. Hooker, however, who had seen a specimen, thought it belonged to *T. repens;* and a careful examination of Don's and Mr Melvill's specimens leads me to think that it is almost identical with the var. *barbatum* of *T. repens.* The plant can probably be found again, and a careful study of it on the spot will probably settle any doubtful points with regard to it that still remain.

Dr F. B. White also exhibited an orange (which had been sent by Dr Baird) showing a smaller orange in the centre.

Mr Henry Coates exhibited specimens of *Helix nemoralis*, and read the following notes:—

The shells which are laid on the table to-night were handed to me some time ago, along with others, by Dr Buchanan White, to name and mount for the Museum. They were gathered in the summer of 1869 or 1870 in the neighbourhood of Balgowan by a gardener or keeper there, by whom they were given to Mr J. Dawson for the Society. They all belong to the species *Helix nemoralis* L., the "Common Banded Snail," and are remarkable for the extraordinary amount of variation which they present, and which I have not seen equalled in a series gathered within so comparatively small an area. I have submitted them to Mr J. W. Taylor, of Leeds, editor of the *Journal of Conchology*, who has kindly sent me some notes upon them. I have also compared them with his list of varieties in that journal and with Jeffrey's descriptions, and have made out nine varieties, besides the type. It may seem at first sight a mere waste of time to divide a species into a number of groups differing only in the colour, banding, shape, and size of the shell, and to give to each of these a distinct name; but we must bear in mind that from a biological point of view, it is always of use to record variations of species, and, in the present instance, the interest arises in all these varieties having been found in one locality. The unnecessary multiplication of varieties, and also of species, is certainly to be deprecated; but when a variety with well-marked characters has been described, we may learn something regarding the history of the species by tracing the occurrence of such a variety in different parts of the country, and noting the effect of surrounding conditions on its distribution. For this reason, I have, in arranging the land and fresh-water shells for the Museum, represented as many well-established varieties as possible, but much yet remains to be done in this direction in working up the Mollusca of our district. It has long been a matter of controversy whether the forms referred to in this note should all be included in one species, or divided into two. Of the two authorities already mentioned, Dr J. G. Jeffrey adopts the former view, and Mr J. W. Taylor the latter. As I have adhered to Jeffrey's arrangement throughout, I have done so in this instance as well. I think his arguments for making one species only are conclusive, for the animal is practically the same in both forms, and the shell appears almost or completely to merge from the one into the other.

I shall briefly describe the varieties comprised in the series. The typical form (sometimes called *quinquifaciata*) has a yellow or chocolate ground, five brown bands, and a brown lip; and measures from ¾-inch to 9-10th-inch in diameter. The first variety, *hortensis* Müll., is that for which the dignity of a species is claimed. The shell is rather smaller and more globular than in the type, the ground a dull lemon yellow, and the lip white. Var. *minor* Moq. possesses the characters of the preceding variety, but with a smaller shell, measuring about 5-16th-inch. Var. *hortensis-lutea* Moq. also resembles *hortensis*, but is destitute of bands. This is a very beautiful variety, with a bright yellow shell and white procelain lip, and is by no means common. Dr Buchanan White has handed me some specimens for the Museum, gathered by himself in Glen Tilt at an altitude of 1600 feet. Vars. *libellula* Risso. and *castanea* Moq. have a ground colour of yellow and chestnut respectively, a brown lip, and no bands. Var. *hyalozonata*, Taylor, has the bands translucent. There is a single specimen of this curious variety in the Balgowan series, which has the mouth contracted, lip white, second whorl very large, and spire rather produced. Var. *cincta*, of French authors, is encircled by a single narrow band on the centre of the whorl. This is the central of the five bands, the four lateral ones being absent. The lip is brown. Var. *coalita*, also of French authors, has two or more of the bands coalesced together, with the lip also brown. Mr Taylor describes in the *Journal of Conchology* (vol. iv. p. 46) a formula by which the variations of banding may be very conveniently expressed. The bands are numbered 1, 2, 3, 4, and 5 respectively, commencing from the

upper part of the whorl, or that nearest the spire. The typical form, where all the bands are present, is described as 1.2.3.4.5., and those varieties which are destitute of bands as 0.0.0.0.0. Var *cincta*, which has only the third band, would be 0.0.3.0.0. Where two or more bands are coalesced, as in var. *coalita*, the numbers corresponding to these are enclosed in brackets. Thus the following combinations are represented in the Balgowan series:—(1.2.3) (4.5); (1.2) (3.4.5.); 1. (2.3) 4.5 and (1.2.3.4.5). In the last of these it will be seen that all the bands are coalesced in one broad mass which covers the greater part of the whorl.

The foregoing notes may serve to indicate the infinite amount of variation which is to be met with in this most variable of British snails.

In conclusion, Mr Coates said that he should be glad to receive any quantity of specimens of these or other Perthshire shells for the Museum. The localities where they had been found should be mentioned. The specimens might be sent to the Museum alive; but if the collector desired to prepare them, all that was required was to drop them into boiling water to kill the animal, which could then be extracted by a pin. Small shells, however, required no preparation.

The following paper was read :—

"*Evolution, and some things said regarding it.*" By Rev. A. Milroy, D.D., Moneydie.

Though this paper professes, by its heading, to treat of evolution, as well as of things said about it, yet it may be as well at the outset to state that it is mainly concerned with the latter. I deem it unnecessary to explain to the members of this Society the doctrine of evolution and the arguments by which it is supported; and even if it were necessary, the attempt to compress a statement and vindication of the theory within the limits of the opening part of a short paper could produce only inadequate and unsatisfactory results. A clear statement of the doctrine and an intelligent summary of the evidence on which it rests, as well as of the evidence which is yet lacking, would be a very interesting and profitable subject. I trust some of the younger members will take it up and give the Society the results of their investigations. The doctrine of evolution was not absolutely new when it was published in a systematic form by Darwin. It was known in metaphysics, before it appeared in natural science. Hegel, starting from pure idealism, threw out speculations which, carried on by others, resulted in a theory of evolution. Coming from metaphysics to physics, we find that the theory was published by two men at the same time. On July 1st, 1858, Mr Charles Darwin gave a paper to the Linnean Society of London, stating the conclusions which had been at first suggested to him by the facts which came under his observation in South America while acting as naturalist on board H.M.S. Beagle, and had been confirmed by subsequent extensive and prolonged investigations. On the same day a paper was submitted to the same Society from Mr Alfred Russell Wallace, giving the conclusions at which he had arrived from observations made by him while exploring the Malay Archipelago. These two naturalists had been prosecuting their researches, independently of each other, in regions far asunder, and the conclusions at which they had arrived on the origin of species were, in the main, identical. In this way the formal doctrine of evolution was first published. There had been glimmerings of such a theory long before that time. Darwin himself gives us an interesting "historical sketch of the progress of opinion on the origin of species, previously to the publication of the first edition" of his own book on the subject. From this sketch it clearly appears that the theory had been held and taught long before it had been promulgated by Darwin. Among the naturalists who held such a view we find the name of a Perthshire man, Mr Patrick Matthew, who, in his work on "Naval Timber and Aboriculture," published in 1831, (a reprint of which will be found in the first volume of the *Scottish Naturalist*) gives the same views on the origin of species as Mr Darwin and Mr Wallace laid before the Linnean Society in 1858. The conclusions at which Darwin had arrived, "with a few facts in illustration," were published in 1859 under the title of "The Origin of Species." The idea itself was not original; it had been mooted before, but to Darwin belongs the merit of working it out—of collecting and arranging the evidence in support of it, of carefully reading the varied records of nature, and showing how these records corroborated the theory, The immediate effect of the publication was to create almost a revolution in the study of natural science. It aroused, of course, bitter opposition, which has by no means died away. The contest is still proceeding, but, generally speaking, the victories are gained by the evolutionists; one stronghold after another is stormed and taken, and their ranks are always augmented by defections from the opposite side. It would be impossible to give a better statement of the view than that which is given by Darwin himself in the closing sentences of his work :—"It is interesting to contemplate a tangled bank, clothed with many plants of many kinds, with birds singing in the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately-constructed forms, so different from each other, and dependent upon each other in so complex a manner, have all been produced by laws acting around us. These laws, taken in the largest sense, being growth with reproduction; inheritance which is almost implied by reproduction; variability from

the indirect and direct action of the conditions of life, and from use and disuse; a ratio of increase so high as to lead to a struggle for life, and as a consequence to natural selections, entailing divergence of character and the extinction of less-improved forms. Thus, from the war of nature, from famine and death, the most exalted object which we are capable of conceiving, namely, the production of the higher animals, directly follows. There is grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms or into one; and that, whilst this planet has gone cycling on, according to the fixed law of gravity, from so simple a beginning endless forms, most beautiful and most wonderful, have heen, and are being, evolved." Such is Darwin's own summary of his views. The theory has to do with the way in which life has been developed in its endless varieties and stages, not with the way in which life originated. Life in its lowest form exists before the Darwinian theory comes into play. It is not necessary in this theory to regard life as having existed at first only in one form. Darwin speaks on this point with an amount of modesty and caution which is sadly lacking in some of his followers. He says:—"I believe that animals are descended from at most only four or five progenitors, and plants from an equal or lesser number. Analogy would lead me one step farther—namely, to the belief that all animals and plants are descended from some one prototype. But analogy may be a deceitful guide." This view has heen vigorously opposed by some scientists, hy some theologians, and by some poets and general writers. Scientists declare that the evidence is as yet altogether insufficient to warrant such sweeping conclusions; the opposition by theologians has been mainly directed against the conclusions in morality and religion to which they think such a view would lead; while the general writer chiefly holds up to ridicule the alleged descent of man from his immediate predecessor, the ape. Still, in a popular assemhly, an allusion to the monkey and a question as to what has become of the monkey's tail, are sufficient to produce roars of laughter, and an impression on the minds of the majority that the theory is a piece of ahsurdity. Of the poets we may take Browning's description. England has no greater poet — and in "Prince Hohenstiel Schwangau," he gives us the descent of man as follows:—

> That mass man sprang from was a jelly lump
> Once on a time; he kept an after course
> Through fish and insect, reptile, bird, and beast,
> Till he attained to be an ape at last,
> Or last but one.

The course pursued here in the process of development from protoplasm to monkey, is slightly erratic. The creature who passed through these successive stages of existence must, like Neil Gow once on a time, have heen much more bothered with the breadth of the road than with the length of it; but still though the course is a little zigzag, the starting-point, the jelly, is quite correct, and so also is, in a certain sense, the penultimate stage, the ape, from which the man emerges. But between stating and ridiculing that theory and showing its falsity, there is a terribly wide and essential difference. Many scientific truths now universally accepted were, when first introduced, regarded by the vast majority as being outrageously ahsurd. To ridicule a theory is not to disprove it. On the other hand, there is not unfrequently on the part of the supporters of evolution undue confidence of assertion, and intolerance of any views opposed to them. They are quite sure that they are right, and consequently, if others differ from them, they who differ must be wrong. They forget that evolution is only a theory, which cannot yet be said to be absolutely proved. Mr Darwin himself, with characteristic candour and modesty of assertion, states the objections and difficulties which may be justly urged against his theory, and acknowledges that he himself felt their weight. All that he claims is that "they are hy no means sufficient to overthrow the theory of descent with subsequent modifications." This modesty of statement disappears in some of his followers, who are characterised hy strong dogmatism, assumption of infallibility on this point, and utter intolerance of divergence of opinion. These characteristics are not found in the best scientists, and should not be found in any. At the most evolution is only a very probable theory. Agassiz, one of the most eminent naturalists, rejected it as unfounded; and though it finds acceptance at present with most naturalists, it is accepted hecause, in their opinion, it accounts better for the facts than any other hypothesis or theory. But still this preference is provisional. It is acknowledged that the theory has difficulties which are yet unsolved. It is not improbable, at least it is quite possible, that subsequent investigations may reveal facts which may greatly modify or even supplant it. What is the position to be adopted? Moderation on both sides—it is at best only a theory very probable, but not yet ahsolutely demonstrated. Toler. ance on both sides—neither may have yet arrived at truth; and on neither side should there be an assumption of knowledge which is not possessed. Respecting what the theory professes to explain, a vast amount of evil speaking on both sides might have been

avoided if the proper object of the evolution theory had been regarded. It professes to account for the origin of species, but it does not ever profess to account for the origin of life. Let us suppose that further investigations have been made and have succeeded in discovering what is still lacking; that adequate causes have been found which fully account for all the infinite variety of form; that the missing links have been got, and that now there is a continuous chain reaching from man to the urschleim, or protoplasm; and starting from man let us go back link by link till we reach the Bathybius, there we find living albuminous substance—we find life, and life according to this theory with all its vast potentialities. The same question that met us at the highest end of the chain meets us at the lowest—how did this life originate?—and to that question evolution neither gives, nor professes to give, any answer. It professes only at the utmost to explain how life rises from a lower to a higher development, but it does not profess to explain how life, capable of all these developments, at first originated. The chasm between matter *minus* life and matter *plus* life still remains unbridged. How does matter *minus* life become matter *plus* life? Here evolution is dumb. But though evolution be dumb, some evolutionists speak if not lucidly at least vehemently. Darwin himself stands in marked contrast to some of his scholars. He says plainly—"Science as yet throws no light on the far higher problem of the essence or origin of life." He for himself attributes the origin of life to the direct act of God. "There is grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms or into one." This attribution of the origin of life to the Creator seems to have aroused a feeling of indignation in some of his followers. We take one instance from abroad and another from home. Zöllner, whose name is deservedly great alike in science and philosophy, holds that Darwin ought never to have written the words now quoted, seeing that "the hypothesis of an act of creation (for the beginning of life) would not be a logical but a merely arbitrary imitation of the causal series against which our intellect rebels by reason of its inherent craving for causality." If now it should be said that the craving for causality is amply satisfied in tracing the origin of life to the Creator, Zöllner is ready with the answer:—"Whoever does not share this craving (for physical cause beyond physical cause) is beyond help, and cannot be convinced." That is, if we do not agree with Zöllner, he tells us we are blockheads, and it is of no use to argue with us. We are consigned to the region of helpless imbecility. Dr Johnson once, with his accustomed politeness, observed to a man who did not see the force of his reasoning—"Sir, I have furnished you with an argument; I am not bound to furnish you with an understanding;" but the inconclusiveness of the argument may be occasionally the fault of the reasoner, and that we submit is the case in Zöllner's present reasoning. We take our second instance at home. In his *Chapters on Evolution*, Dr Andrew Wilson, speaking of the belief that each of the various species of animals and plants originated as a special creation, says:—"In this way a creative interference, capable of originating living beings *ex nihilo*, and, therefore, capable of literally creating matter—itself an inconceivable act—was credited." Dr Wilson here asserts—it must be acknowledged, however, that he asserts it only in a parenthesis—that the creating of matter is an inconceivable act. Now, first of all, a scientist should never state incidentally, by way only of parenthesis, what he wishes to be regarded as an important and fundamental truth. He should state it boldly, and show honestly the grounds on which it rests. The argument indicated in this parenthesis rests on mere assertion. Life is said by some evolutionists to be simply the outcome of the chemical and physical properties of matter. This, again, is mere assertion. The chemist can resolve man's frame into its constituent elements, but when he has done so he is no nearer the secret of the origin of life. He was all the while operating, not on living tissue, but on the shell in which life had once existed. The house may once have been full of life, and love, and happiness, and have rung with the shouts and laughter of children; but when the dwellers have all gone, when the house is left empty and desolate, you will never discover the secret of the life and merriment which once were there, even though the search from garret to basement should be minute and exhaustive. The problem of the origin of life is confessedly unsolved on physical principles, but when knowledge utterly fails, hypothesis is resorted to, and pure hypothesis is stated so boldy as to seem a simple narration of ascertained facts. Haeckel describes the process of the spontaneous origin of organisms, and their power of separating into two or more portions,—that is their power of reproduction,—as plainly as he might describe the process of manufacturing wooden nutmegs. Organo-genetic elements coalesce and form an albuminous granule. The albuminous granule transforms itself into a homogeneous organic individual. This individual grows by means of nutrition till the attractive power of the centre is too weak to hold the whole mass together. The mass thereupon separates, and each part becomes an albuminous individual, and there the whole mystery is solved. The secret of the origin of life is just as plain as the art of making clay into bricks. The explanation of

Haeckel is founded on suppositions, and explains nothing. Is it any explanation of the origin of life to say that a certain combination of organo-genetic elements of carbon, oxygen, hydrogen, and nitrogen, becomes a molecule of albumen, which ultimately transforms itself into a living substance? We may arrange the atoms of carbon and the other materials in the certain combinations, and we see that only dead matter is the result. The wooden nutmegs so far resembled the real article, that they were bought, and the buyers only discovered their mistake when they bit them, but Haeckel's mixture has not even this outside resemblance to living tissue. Life is still wanting. We have here confessedly only guesses and imaginations, and mere guesses and empty imaginations do not form the basis on which actual science rests. Much of what has been said against the doctrine of evolution might have remained unsaid, if a clear distinction had been drawn between the theory itself and the opinions and statements of some who have embraced that theory. Evolution is one thing, the opinions of some evolutionists is another thing. Evolution professes to account for the origin of species alone, and is not responsible for what evolutionists may say when, leaving this question, they attempt to account for the origin of life. Some of our own evolutionists come far short of their continental brethren in boldness and plainness of speech. Thus, in a popular treatise on the subject, published last year, I read:—"It seems illogical to deny that whatever properties the protoplasm of germ or adult exhibits, depend, strictly speaking, upon the chemical and physical properties of that substance." A like conclusion is introduced by such phrases as "Thus we approach the idea," "This leads us to think of the possibility and probability." These phrases "It seems illogical," "We approach the idea," "We are led to think of the possibility and probability," occur at the crucial point of the argument, and these seemings, approaches to the idea, thinking of the possibility and probability, form the grounds on which a materialistic view of the origin of life is reached. Surely the logical and scientific course in these circumstances was not to arrive at a positive conclusion, but to investigate and to wait till seeming had become reality, till the approach to the idea had become the arrived at it, till thinking of the possibility and probability had evolved into certainty. The other week I read in a provincial paper a report of a scientific lecture delivered in a county town. The town was not Perth. The lecturer, addressing a mixed audience, the great majority of whom had the vaguest notions, if they had any, of evolution and the grounds on which it rests, informed his hearers that the evolution theory was the work of some of the greatest minds of our generation; that the evolution views were the matured deliberations of the most accomplished anatomists and naturalists; that these views must be adopted by all who wished to be regarded as reasonable and intelligent; to adopt these views was to take a place in the most advanced school of science; to reject them was to take a place in that class which is composed of the old women of both sexes. Whether these statements represent the sentiments of the lecturer, or the reporter's impression of the lecturer's sentiments, I do not know, but there can be no doubt that, whether such sentiments were uttered or not on that occasion, they were sentiments which are widely current. Such an advice would have been reprobated by Darwin, and will be reprobated by none more strongly than by his reasonable followers. Such an advice with regard to any school, be it advanced or lagging behind, is mischievous. To enquire simply on the one hand what opinions are the most advanced, or on the other what opinions are reckoned safe and sound, and to adopt them merely because they are advanced or because they are safe and sound, is not the study of science, nor is it even a wretched pretence of an imitation of scientific study. A young man may enter an emporium of fashion, may see and choose the newest fabrics and devices, and, having made his selection, may come forth the lawful owner and wearer of the results of the most advanced ideas of the tailor as shown in the latest product of his artistic skill; but the young, or, for the matter of that, the old man cannot enter the emporium of science, ask there to be shown the latest and most advanced opinions, and when they are spread before him say these are the opinions for me. I choose them, and therefore I am now a man of the most advanced views, and entitled to look down with scorn on others as laggards and dotards. No, reading, research, meditation, honest work, can alone lead to the real adoption of any views. Without these essential antecedants, we may adopt advanced or non-advanced, new or old opinions, but we assume them as a certain animal, once on a time, assumed the lion's skin, and found that though the outward aspect was that of a lion, the voice was the voice of an ass. Pope truly says that—

> Index learning turns no student pale,
> Yet holds the eel of science by the tail.

But it must at the same time be acknowledged that, if we hold the eel only by the tail, we have a very short and slippery grip. While on the one side there are men who profess to hold evolutionist views, simply because they

falsely deem that such a profession gives them a claim to be ranked as men of advanced opinions; there are on the other side many who in utter ignorance denounce these views because such denunciation is thought to stamp them as safe and sound. There are many men who have never weighed or even read the arguments in support of the views, and who are utterly unfitted to read them with unbiassed judgment, who denounce them as tending to raze the very foundations of morality and religion. Men very frequently contend with great eagerness for what they regard as the cause of truth, when they are in fact contending only for the worn-out garment in which truth was once arrayed. The cause of morality and religion rests on truth, and that cause can never be strengthened by beliefs which are based on error. They are mistaken, though well-meaning, defenders of the bulwarks of that sacred cause who deem that she can thus be buttressed. Having truth for her foundation, she derives strength from every fresh discovery whereby truth is brought to light. Of the attempts of evolutionists to show how instinct, habit, reason, and conscience arise—how they attempt to show that the highest mental powers aud the highest products of mental power all proceed from the nerve-energy stored up within the cells of the nerve-centres, we have not time even to speak. The idea of evolution existed away in the distant past, and its past aud future have frequently formed the theme of poets. Our own Poet Laureate, in an exquisite poem, published long before the doctrine of evolution had a footiug in the scientific world, speaks of a being that shall, when

> Moved through life of lower phase
> Result in man, be born and thiuk,
> And act and love, a closer link
> Betwixt us and the crowning race
>
> Of those that, eye to eye, shall look
> On knowledge; under whose command
> Is Earth and Earth's, aud iu their hand
> Is Nature, like an open book;
>
> No longer half-akin to brute,
> For all we thought and loved and did,
> And hoped, and suffered, is but seed
> Of what in them is flower aud fruit.

Yes, there is truth in the anticipation of our poets. I believe from high teaching in evolution in the spiritual world. As dead matter in the physical world was inspired with the breath of life, so in the spiritual world, I am told, that that which was dead was quickened. In the spiritual world there is the bitter struggle to maintain this life—there is the survival of the fittest—there is the development from a lowly beginning to a state whose glory it has not entered into the heart of man here to conceive. While we listen to jeers, and denunciations, and anathemas uttered against Darwin and his system, this at least we may safely say, that the account of the origin and progress of the spiritual life, as described in Scripture, is analogous to what the doctrine of evolution, properly considered, teaches was the case in the life which we see in the animated world around us.

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### March 6th, 1884.

### *ANNUAL MEETING.*

Colonel Drummond Hay, C.M.Z.S., President, in the Chair.

NEW MEMBERS.

The following were elected:—

*As Ordinary Members.* Mr W. Westwood, Princes Street; and Rev. A. Campbell, Free Church, Errol.

*As Corresponding Member.* Mr E. P. Ramsay, F.L.S., Curator of the Australian Museum, Sydney.

*As Associates.* Mr Laidlaw, gamekeeper, Castle Menzies; and Mr Macdonald, gamekeeper, Rannoch Lodge, in acknowledgmeut of their many contributions to the Perthshire Collection.

The following were nominated:—Miss Mercer, Miss Louisa Mercer, and Miss Charlotte Mercer, Balcraig; and Mr R. S. Trotter, 2 Tay Street.

DONATIONS.

The following were intimated:—

*For Index Collection.* Stem of araucaria, from Deacons' Court of Free West Church.

*For Perthshire Collection.* Star-fish, from Mr Henderson, Dundee; salmon fry, from Mr Lumsden, Superintendent of Tay Fisheries; one otter, one mountain hare, one brown owl, one goosauder, and five snow buntings, from Mr Macdonald, gamekeeper, Rannoch Lodge; several crossbills, from Mr M'Gregor, Ladywell; two crossbills, from Sir Robert Moncreiffe, Bart.; buzzard and four rabbits, from Mr Macdonald, Rannoch Lodge; magpies, from Mr T. Roy, Craigclowan; velvet scoter, from Mr T. Marshall, Stauley; crossbills, from Mr M'Leish; merganser (stuffed), from Mr J. Lorimer, birdstuffer, King Street; garnets, from Dr Buist; a number of shells of *Helix memoralis L.*, collected near Almondbank, and represeut-

ing six varieties, from Mr Henry Wilkie, Barrack Street; peregrine falcon, from Lady Helen Macgregor, Edinchip; six slides of diatoms from the Tay opposite the North Inch, from Dr Trotter.

EXHIBITIONS.

Dr Buchanan White exhibited specimens of a new British plant from the Society's herbarium. The plant in question is a kind of clover,—*Trifolium agrarium L.*,—and was found by Colonel Drummond Hay and himself near Loch Cluny in 1872. He had also found it more recently near Forteviot. In the latter locality it might have been introduced (it was found in similar places near Aberdeen), but in the former it had the appearance of a native. *Trifolium agrarium* probably only required to be looked for to be found in other places, as it might be readily passed over from its resemblance to the common yellow clover—*Trifolium procumbens L.* The points of distinction between the two species were pointed out by Dr Buchanan White.

Mr Herd, Moncreiffe, exhibited a specimen of fungus (*polyporus*); a blue boulder stone of thick texture, found on Moncreiffe Hill; and an oyster shell, to which part of the root of an oak had attached itself in a curious way.

THE LATE SHERIFF BARCLAY.

The Secretary reported that the following record had been entered in the minutes respecting the late Sheriff Barclay:—"The Society desires to record the loss it has sustained by the lamented death of Sheriff Barclay, who always took a keen and active interest in the Society and its proceedings. He was elected an ordinary member in March, 1871, and held the offices of Councillor and Vice-President respectively from the year 1876 to 1878, and was a regular attender of the meetings."

REPORT OF THE DELEGATES TO THE CONFERENCE ON THE FEDERATION OF SOCIETIES.

Dr Buchanan White reported that Mr Robert Pullar and he, the delegates appointed at last meeting, had attended the Conference held in the Society's lecture-room on February 9th. Nine Societies were represented by delegates at the meeting, and, after a considerable discussion, the Constitution, which had been submitted to the Council of our Society for consideration, was adopted with a few trifling amendments. After that had been done it was resolved to federate the Societies in the counties of Aberdeen, Fife, Forfar, Kincardine, Kinross, and Perth, under the title of the "East of Scotland Union of Naturalists' Societies." The delegates of five of the Societies (including our own), having powers to do so, then announced that their respective Societies would join the Union, while the delegates of the four remaining Societies agreed to recommend their Societies to do the same. These Societies, along with another, have since joined the Union, which now includes all, except two or three, of the Naturalists' Societies in the district of the Union. The number of members in the federated Societies is probably upwards of 1200. It was agreed that the first annual general meeting should be held in Dundee in June next, and Dr Buchanan White, F.L.S., was unanimously elected President, and Mr F. W. Young, F.R.S.E., Dundee, Secretary, of the Union.

REPORT OF THE COUNCIL.

The Council, in presenting the Seventeenth Annual Report, has, as in former years, to congratulate the members on the continued prosperity of the Society.

During the past Session six ordinary meetings were held, the average attendance at which was 30. At these meetings eight papers (in addition to shorter communications) were read, the number of authors being six. From these statistics it will be seen that the average attendance has been nearly double that of the previous Session, which is perhaps due to the fact that all the meetings are now held in the evening, and not alternately in the afternoon and evening as hertofore. The Council wishes to call the attention of members to the need that there is for improvement in the matter of papers and communications, the number of these being below what the members ought to produce.

During the past year four long excursions were made, particulars of which will be found in the "Proceedings." As usual, the best thanks of the Society are due to those landowners who kindly granted permission to go over their properties.

To the roll of the Society 49 ordinary members have been added during the past Session. The membership of the Society is now 321, including 2 Honorary and 7 Corresponding Members, and 4 Associates.

The hope expressed in last year's Report that the arrangement of the Museum would be sufficiently advanced, to allow of its being opened to the public, has been realised. It was formally opened on the 20th of December last, on which occasion a conversazione, on a large scale, was held, and was well attended. Since the Museum was opened, it has been visited by upwards of 7000 persons, and though the majority of these came on the occasion of the opening, and on New-Year's-Day and Handsel-Monday, there has been a large number of visitors every week. Though the Museum has been thus thrown open, a great many specimens are still required for the Perthshire

Collections, and donations of animals, plants, or minerals will be always acceptable.

On the 9th of February, a meeting of delegates from a number of Scientific Associations in the East of Scotland was held in our Lecture-Room to discuss the question of, and if deemed advisable found, a Federation of the various Societies. After deliberation, it was resolved to form a Federation, under the title of "The East of Scotland Union of Naturalists' Societies." Your delegates, having been empowered to do so, agreed that the Society should join the Union. The first meeting of the Union is to be held in Dundee in June, and a member of this Society has the honour of being the first President.

It may be mentioned that during the past year the use of the Lecture-Room has been granted to the "Perth Women's Educational Association" for several courses of lectures, and to the "Royal Perthshire Horticultural Society" for meetings.

Your Council has not been idle during the past session, having held 23 meetings.

### REPORT OF THE TREASURER.

By Mr John Macgregor.

The income of the Society during the past financial year (namely, from 1st January, 1883, to 29th February, 1884) has been £113 13s 5d; and the expenditure, £104 7s 8d, leaving a balance in bank of £9 5s 9d. The number of paying members elected during the financial year has been 49. As this is the last report that I have to give as Honorary Treasurer, I may be permitted to allude to the gratifying fact that, in the seven years during which I have held that office, the number of paying members has increased from 115 to 308, and that the number is still increasing. There are, however, 9 old members and 9 new members in arrears with their subscriptions, representing a sum of £6 1s 6d. In the interest of the Society, it would be of importance to have these paid up without delay.

### REPORT OF THE LIBRARIAN.

By Mr James Coates.

The volumes in the Library now number upwards of 460, of which about 325 belong to the Lending Library and the remainder to the Reference Department. During the past year 46 members have taken books from the Library, and 110 different volumes have been taken out. As it is only for a year that the Library may be said to have been fairly in working order, the extent to which it has thus been taken advantage of is considered very fair. At the same time it is hoped that the number of readers will continue steadily to increase. A considerable number of volumes have lately been added to the Library by purchase and by presentation. Among the donations may be specially noted the series of *Land and Water* and *Gardener's Chronicle*, from Colonel Wedderburn Ogilvy.

### REPORT OF THE EDITOR.

By Mr Henry Coates.

The only publication which the Society has issued during the past year is the Third Part of the "Proceedings." By an unfortunate printer's error, this was marked Vol. II., Part III., instead of Vol. I., Part III. I call attention to this as it might lead to confusion, if not explained. Being printed only on the temporary cover, it will not affect the volume when complete. The present series was commenced in 1880, mainly as an experiment, and the result has encouraged the Council to continue the issue in a permanent form. It cannot be doubted that to preserve a record of the work done by our Society enhances the value of that work in a scientific sense; but to make the record really valuable it is greatly to be desired that many more members would come forward with notes, however short or unpretentious, of anything that will throw light on the natural history of our district. Were this done, not only would the interest of our meetings be increased, but greater progress would be made in working out the local fauna and flora.

In the Editor's Report of last year it was intimated that the Council had reluctantly decided to discontinue the publication of the *Scottish Naturalist*. It must be a matter of satisfaction to all that this journal, though not now connected with our Society, has not been allowed to become extinct, but is being carried on by our Corresponding Member, Professor J. W. Trail, of Aberdeen.

### REPORT OF THE CURATOR.

By Colonel Drummond Hay, C.M.Z.S.

As I shall have occasion to make allusion, in my address as President, to the progress and advance made in the several branches of the Natural History Department for the past year, it will not be necessary for me to say much now on the subject, further than to mention that progress is steadily being made; and as regards the local collections, that many donations have been received from all classes in the county—from the proprietor to the working-man; and from the latter we have had several interesting contributions made since the opening of the Museum, shewing that a real interest is taken in it by the public. Several donations have also been received from various sources in behalf of the Index Collection. All these donations are most thankfully received; and though some of them may not at once be put in the cases, they are carefully kept till

room is obtained for them. Our progress, as I have said, is steady, though slow, and perhaps slower than it ought to be. I would, therefore, again draw attention, as I have done on former occasions, to the fact, that the Society is most anxious, and especially now that the Museum is open to the public, that the local fauna should be completed as early as possible. Many species once abundant in the county, more particularly among the mammals (such as the wild-cat, martin-cat, pole-cat, &c.) have become so rare, if not extinct, in the county, that it is necessary that these be supplied by securing stuffed specimens of those that have been got in former years, of which, no doubt, there are many still existing in the county. It is earnestly hoped, therefore, that those possessing such,—and who, perhaps, may not attach much value to them, but have them placed, as is sometimes the case, in some out-of-the-way corner, or on some backstair, where they are seldom seen,—will kindly allow them to have a place in the Museum on loan, should the possessor not wish actually to part with them. Every care will be taken with regard to their safety, and the specimens restored when required. Besides mammals, there are some of our larger birds of prey, as well as the larger species of web-footed birds, to which this applies, such as the fishing or white-tailed eagle, golden eagle, osprey, swans (of which there are three species), the mute-whooper, and Bewicks, and some of the geese, the white-fronted and the beau, now seldom seen. It may be as well, however, to remark that these would all require, for the time being, to be placed on the Museum stands, and returned in their cases or otherwise, when restored, which they would be, in the same way as they were received. The particulars as to each specimen on loan are being duly entered in a book kept for the purpose, stating date and name of lender, and the same is put on the labels. I can only trust that when the Curator's Report is laid before you again, it will be found that a hearty response has been made to the appeal, for in no other way can we expect to obtain many of these rarities, or speedily to make the Perthshire Collection as perfect as it should be, without waiting for many years, and not perhaps even then.

On the motion of Dr Trotter, seconded by Mr John Stewart, the Reports were approved of.

### APPOINTMENT OF AUDITORS.

Mr John Dawson and Mr C. Law were appointed auditors.

### ELECTION OF COUNCIL FOR 1884-85.

The following were elected office-bearers and members of Council for the session 1884-85:—

F. Buchanan White, Esq., M.D., F.L.S., *President.*

Captain D. M. Smythe, Yr. of Methven,<br>S. T. Ellison, Esq.,<br>John Macgregor, Esq.,<br>James Stewart, Esq., } *Vice-Presidents.*

John Young, Esq., C.E., *Secretary.*

John Stewart, Esq., *Treasurer.*

Colonel H. M. Drummond Hay, C.M.Z.S., of Seggieden, *Curator.*

James Coates, Esq., *Librarian.*

Henry Coates, Esq., F.R.P.S., *Editor.*

A. Sturrock, Esq., Rattray,<br>R. D. Pullar, Esq., F.C.S.<br>Dr Trotter. } *Councillors.*

Mr A. Coates, in moving a hearty vote of thanks to the retiring President and office-bearers for the valuable services rendered by them to the Society, said the past year had been one of peculiar interest in the history of the Society, in the opening of the new Museum. For some years previously the work of the Society had been more of a preliminary nature, but the Society might be now said to be full fledged, as it had presented to the world a Museum which was becoming every day more and more a complete local collection of natural history objects—a collection which the members of the Society had been informed, in the various addresses which had been delivered at its inauguration, was more valuable to the community than any mere general collection. The various office-bearers of the Society had rendered great service in carrying out the details in connection with the conversazione at the formal opening of the Museum, and therefore, for these and other services performed by them in the cause of science throughout the year, he had much pleasure in moving a cordial vote of thanks to the retiring President and office-bearers of the Society.

Mr R. Pullar seconded the motion, remarking that the office-bearers deserved all the thanks they could give them for the great amount of work which they had performed during the year.

The motion having been carried with acclamation,

Dr Buchanan White returned thanks in behalf of the retiring office-bearers.

PRESIDENT'S ADDRESS.

Colonel DRUMMOND HAY, C.M.Z.S., then delivered his valedictory address as follows:—

This year completes the sixteenth of the existence of the Perthshire Society of Natural Science, and has been the most eventful in its history. The purposes for which it was first instituted have been attained, and the fond hopes of the Society consummated, in the possession of a good local Museum for the edification and instruction of the people in the several branches of natural history. Thereby it is hoped it may be the means of cultivating tastes for enquiry and observation, as well as affording innocent occupation and recreation in the investigation of the natural objects around us. Perhaps no part of Scotland can boast of a larger or a more varied share of these, or greater facilities of research, than are to be found, not only in the county of Perth, but in the vicinity of the city itself. Our noble river, and its neighbouring hills, and even our Inches, are productive of many a rare bird, insect, and plant. These are some of the reasons why the Society was formed, and why the Museum was built. As you are all aware, the late Sir Thomas Moncreiffe, for long President of this Society, took the deepest interest in the Museum scheme, and greatly may it be attributed to his exertions that the building is now an accomplished fact. It will, I am sure, be most gratifying to you to learn what the expression of opinion of scientific visitors from various parts has been, namely, that it is one of the best planned local Museums with which they are acquainted. The formal opening, which took place on the 20th of December last, will be fresh in your memories, as also the advantage which was taken at the time of holding a Conversazione on that and the two consecutive nights, and in obtaining the use of the adjoiuing halls. These, together with the Museum, were all thrown into one for the occasion, and connected by means of a covered way, affording facilities for carrying out the plans of the Committee on an extended scale, and admitting of a magnificent display of the most interesting, as well as instructive, subjects in science, together with a large assortment of scientific instruments, and models of the more recent discoveries of the day. In the Museum rooms were exhibited the several collections illustrative of the fauna and flora of the county. Altogether, the success of the undertaking was proved by the large number of visitors who thronged the halls and Museum night after night, and by the great interest taken in the various departments. This also showed the wisdom of having built the Museum where it is; as, had it been elsewhere, as some would have persuaded, it would have been impossible to have held the Conversazione on such a scale, and perhaps, indeed, to to have had it at all. It may not be here out of place my quoting the opinion of one of the leading scientific journals *(Nature)* on the occasion, which is as follows:—"The enterprise of the Perthshire Society is exceptional, and they have reason to be proud of their Museum, reading, lecture, and other rooms, all of which, we have no doubt, will be put to excellent practical uses." This, I need hardly say, it will always be our endeavour to do.

I must explain that the Museum, though open to the public, must not be supposed to be finished. I am glad, however, to say it is so far advanced as to be able to afford much instruction to the intelligent visitor. The desire of the Society is to make the Museum an instrument of education and instruction, and not a mere collection of curiosities. It was with this view, as I have on a former occasion explained, that, in addition to the local Perthshire collections, it was resolved to have a Typical or Index Collection, explanatory in a concise form of the general scheme of classification, in the animal, vegetable, and mineral kingdoms. This has been done, and the Index Collection, which is mostly arranged on the upper tables, is nearly as complete as it can be in the space at present available for it, and the specimens have all been arranged and labelled. There are, however, still some vacancies in it, and to fill these, as also with a view some day of having more space for it, donations from any part of the world will be acceptable.

Coming now to the other department, viz., the local, or Perthshire Collection, we shall glance at each section in succession, commencing with the zoological sections:—

*Mammals.*—This collection is getting on, but of the few mammals that are natives of Perthshire several species are not yet represented. We trust, however, that it will soon be better, as specimens of some have been received (such as red-deer from Lady Willoughby de Eresby), but are not yet ready to exhibit. Attention in this department is particularly requested to the collecting of field-mice and voles, which, though common, are inconspicuous species that ought to be looked for. The desirableness of getting specimens of the rarer species, such as the wild-cat, martin-cat, &c., have been so fully brought before you in the Curator's Report, that it is not necessary for me to say anything more on that subject.

*Birds.* — Last year the number of species in the Society's Collection was 125. It now amounts to 150, containing from one to several examples of each in various stages of plumage. Also, last year, the total number of species given in the district list, inclusive of

such as will in all probability be found when the fauna is more fully worked out, was 215;—it now amounts to 219, four species having been added, as new to the district, inclusive of the whole basin of the Tay. Of these, three have been obtained, viz., the purple sandpiper, the green sandpiper, and eared dabchick; and, besides these, several other varieties have been added to the Museum, some of which are deserving of particular mention. The grey phalarope, in full summer plumage, being rarely got in this stage (that of winter, in this country, being the more frequent), was picked up last autumn at the foot of the lighthouse at the mouth of the Tay, having dashed itself during the night against the lantern on its southern migration. The little stint and the pigmy curlew, or curlew sandpiper, as it is sometimes called, were also obtained. These are the first examples that have been got in the district, though the latter has been reported from Loch Tay. The green-sandpiper is also a most interesting bird to have obtained, as it is now for the first time confirmed as a Perthshire bird, though suspected to have been seen in Rannoch. This is not an unlikely locality, it being an inland sandpiper, and not a frequenter of the coast. The specimen in question was shot on the Earn by Mr Pitcaithly last September. One peculiarity in this bird, different from all of its genus, is its habit of nesting on trees, which it does on its regular breeding-grounds in Sweden and the northern parts of Europe, generally selecting a fir tree for the purpose, and always choosing old nests in which to deposit its four eggs, at about thirty feet or more from the ground, the favourite being that of the song-thrush, though sometimes the nest of the missel-thrush as well as the wood-pigeon is used, and instances are not wanting of its taking possession of an old squirrel's nest or drey. I mentioned last year that it was in contemplation, in addition to the birds mounted in the larger cases, to have a full collection of skins, for the purpose of comparison, and of more readily studying the several genera. This collection has been commenced, and though a considerable number of specimens have been secured, it has not attained sufficient dimension to admit as yet of its being systematically arranged. This will, however, necessarily take time, as the mounted specimens in the cases must take precedence ; but as soon as their arrangement is complete, they will be placed in drawers in the centre tables for reference and study. Under this head *(Birds)* come nests and eggs, of which a few additions have been made, but not to the extent we could have wished, and now that the nesting season is coming on, it is hoped that contributions may be sent in. To prevent any unnecessary taking of birds' nests, which the Society would greatly deprecate, only those in the list sent out will be required.

*Reptiles and Amphibians.*—The species found in the district are few in number, and not many have been as yet collected; but as it is requisite to have specimens from various parts of the county, also from different altitudes, to illustrate their distribution and variation, any snakes, newts, lizards, frogs, &c., will be thankfully received.

*Fish.*—In this collection there have been several very interesting contributions, among which, from Mr Charles Murray of Taymount, was a magnificent Tay salmon of 54 lb. weight. But a great deal is yet required to be done, and as fish of all kinds are required, both from the inland Perthshire waters, and from the tidal parts of the basin of the Tay, it is hoped that the tacksmen who rent fishings (whose Museum this practically is, as well as that of others), will take an interest in the matter, and give instructions to their fishermen to send any fish that can be spared, especially those that they may get in their nets on the lower waters of the Tay. Many of these, not being marketable, are generally thrown aside, or left to die on the bank, to be carried off by the first tide. I would also especially bring to the notice of all anglers, to spare, if they can, a trout or two out of their baskets, from any stream or loch in the county; these might be quite of ordinary size, as it is desirable to illustrate the variation of the common trout from all our streams and lochs, taken at various seasons. In addition to these, charr, grayling, or any other *salmonidæ*, or other fish than those mentioned, from the different lochs or streams, such as loach, miller's thumbs, minnows, sticklebacks, lamperns, &c., will all be acceptable.

*Mollusca.*—Among these we have also several additions, but, as in the case of the fish, to illustrate distribution and variation, specimens of common land and fresh-water shells are required from all parts of the county. Members and others are particularly solicited to collect these. In all still waters, among weeds, or in burns, on stony and gravelly bottoms, may be found abundance of water-shells; while on mossy banks, under stones and leaves, on many a plant and tree, may be found land-shells of various sorts; —these are all easy to collect, and require no preservation.

*Insects.*—The collection in this branch is also getting on, but as yet has chiefly been confined to the moths. It is hoped, therefore, now that the Museum is open to the public, that there may be many willing hands to assist in extending it to the other families, such as flies *(Diptera)*, beetles *(Coleoptera)*, and others, which, though not yet in the Museum, are not being lost sight of. The latter are easy of preservation, requiring little trouble; if only put

into a small vial with a little alchohol when collecting, this will be quite sufficient for the time.

*Botany.*—The Herbarium now contains many thousand specimens of Perthshire plants. These are in course of being mounted, and when they are, will be available for inspection by members under supervision; but as they are fragile and easily injured, they cannot be left thrown open, as other collections are. In this section may be described the *Perthshire Woods.* A large collection, in addition to those already in the Museum, has been received, and will soon be exhibited in cases, which have been made for the purpose.

*Geology.*—A lot remains to be done in this department, but specimens are coming in. Lessees of quarries are giving examples of the local building stones, which will be useful; but any one might give material help by sending up specimens of the various stones to be found in the boulder-clay, or any specimens of rocks or minerals in their individual neighbourhood. All donors of specimens—whether of plants, animals, or minerals—should be careful to give with them a note of the date and locality where they were got, with name of the donor. All packages to be left or sent addressed to the Curator, Perthshire Natural History Museum, Tay Street, Perth.

In concluding this sketch or review of the work done, and progress made, during the past year, I may say that I am sure it will have been pleasing to you to know that since the opening of the Museum, the number of visitors has been so large, and that all classes of the community continue to visit it; and I am also sure that you will be glad to have heard that so many intelligent working-men spend their Saturday afternoons in the Museum, carefully inspecting the various collections; and evidently doing so not for mere curiosity's sake, but for information and instruction. This is as it should be, and may it be freely used as such. The Museum was thrown open without charge for educational purposes, in the belief that the privilege would not be abused but appreciated; and it is most gratifying to find that such is the case, and long may it continue. I have said the Museum is not finished: this refers merely to the filling of the cases in the spaces that we have for them. So the word must not be takeu to signify the completion of the collecting of specimens of all the natural products of the county and district;—no, for that would take much more room than we have at present allotted to us in the building as it now stands. Even more cases have had to be made, and the Museum-hall is already getting crowded; and yet when completely filled it will not be a representation of the whole natural history of the district in its completed form. It is better that it should be thus, as it will leave work for those who come after us; but at the same time, it is for us to be working too. Fortunately, this is quite practicable, as there are facilities for building an addition behind the present building, upon ground belonging to the Society. In fact, the Society could there erect a much larger building than the present, as it could be made higher; so that if ever it was proposed again (as was suggested before the Museum was built) to amalgamate with the other Musenm in Perth, belonging to the Literary and Antiquarian Society,—that is to say, the natural history portion of it,—there wonld be no difficulty in the way of finding room. Bnt were this ever done, great care would have to be taken by the Perthshire Society of Natural Science that it shonld in no way interfere with or set aside the purely local character of their own Mnseum, but be kept perfectly distinct.

However feasible the place for a new addition may be, or even if were it only the addition of a few extra cases, more money will be required; and while on this subject I would strongly bring before you the suggestion thrown ont by Professor Geikie in opening the Museum, that an attempt should be made to collect an Endowment Fund, to pay current expenses in keeping up the Museum. This conld be done by getting a small sum from every one interested in the educational advancement of his town or county, which "he believes, if brought properly before the public, wonld meet with gratifying support, and in a short time pnt the Museum on an independent footing, and relieve the Society from the present great strain on its resources." I sincerely trust this will be taken up as it should be, and that the suggestion will be found to bear much fruit in the so doing. The maintenance of the Museum is a heavy tax on the income of the Society, which is derived only from the annual subscriptions of members; and this annual subscription is made purposely small, in order that as many persons as possible may have the benefits offered to members, in the way of the Library, &c. This is, therefore, deserving of your most serious attention.

With regard to the average attendance at the monthly meetings, I am glad to report it is on the whole increasing. Many interesting papers have been read at these meetings; and as they are open to the public, they will no donbt, as the Museum gets better known, become more largely attended by non-members than they have been heretofore. This, however, is no fault of the Press for not bringing our doings before the public, which they have invariably done. They are deserving of our warmest thanks, which I now accord, for the way in which they have so well and fully reported, in the newspapers, the proceedings of the various meetings, thereby seconding the efforts of the

Society in promoting a knowledge of science. While on this subject, I may notice the success which has attended the issue of the "Proceedings" of the Society, which has now reached its third part, and for which there is ever an increasing demand. Members should therefore endeavour to make the "Proceedings" more valuable by bringing forward at the meetings notes on the local natural history, the more especially as our Society is one of the few local Societies in Scotland which publish "Proceedings."

In other matters the Society has not been idle, having, in conjunction with other neighbouring Societies, mooted the question of the advantages that would accrue from a Federation of the several scientific Societies in the East of Scotland. A meeting of delegates was accordingly arranged to take place on the 9th of February last in Perth, at the Perthshire Society's Natural History Museum, in Tay Street, when the following Societies were represented from the Counties of Aberdeen, Kincardine, Forfar, Fife, Kinross, and Perth, viz., Aberdeen Natural History Society, Alford Field Club and Scientific Society, Arbroath Natural History Society, Montrose Natural History and Antiquarian Society, Dundee Naturalists' Field Club, Kirkcaldy Naturalists' Society, Largo Field Naturalist Society, and Perthshire Society of Natural Science, being all the Societies but four in the above-mentioned counties. Two of these latter considered that their objects did not quite entitle them to join the proposed Federation, at least for the present; and from the other two no response had been received. [One of these has since joined the Union.—EDITOR.] After deliberation, it was resolved to federate the above-mentioned Societies under the title of "The East of Scotland Union of Naturalists' Societies,"—the objects of the Union being the promotion of good systematic work by the various Societies in it and a friendly intercourse amongst their members; its affairs being conducted by a Council of representative members, two being elected by each Society; the President to be a man of scientific eminence connected with the district; a general meeting to be held annually at the headquarters of the various Societies in rotation; and the first general meeting to take place in Dundee on the 6th of June—Dr Buchanan White, F.L.S., President. This certainly may be considered as a great move in the right direction, especially when we take into account that the Union has a membership of about 1300 to commence with; and if numbers have anything to do with it, good work should not fail the Federation.

But I pass on to another matter, one I can scarcely pass over in silence, namely, as to some of the changes in the office-bearers. I would first and foremost express my extreme satisfaction, as I am sure I do that of all those who hear me, at the election of our new President, Dr Buchanan White, and rejoice that his arrangements leave him free to accept office, and that he is still to remain among us, which we hope may be for long to come. We all know what our new President's capabilities are, but were this not so, the very fact of his having been unanimously chosen the first to preside over so large a body as the East of Scotland Union (as a man of scientific eminence) would have been sufficient of itself. But we know still more,—Dr Buchanan White was the first President of this Society, and one of the foremost of its original promoters, having held the office of President during all its first years. Under his influence and early training the Society took its first start in life, and has grown to what it is now—in its seventeenth year—one of the "leading local Societies in Scotland." Another change I must allude to, which is not to my mind so pleasing, and that is the retirement of Mr Macgregor from the Treasurership, an office which he has held for so many years, and the affairs of which he has conducted in so efficient a manner. I therefore beg to return him our hearty thanks on his retirement.

I feel that I could not close this address without expressing our sorrow at the loss the Society has sustained by the death of one of its oldest members, one who has held office as Vice-President, and has been for so many years a member and a constant attendant at our meetings, I mean the late Sheriff Barclay. Though not an active naturalist, yet he sympathised most cordially in the objects of the Society, and did all he could to promote them. He will, in consequence, be much missed among us, and his demise deeply regretted.

On the motion of Mr R. PULLAR, seconded by Mr BROWN, a cordial vote of thanks was awarded Colonel Drummond-Hay for his address.

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APRIL 3rd, 1884.

DR F. BUCHANAN WHITE, F.L.S., President, in the Chair.

NEW MEMBERS.

The following were elected:—Miss Mercer, Miss Louisa Mercer, and Miss Charlotte Mercer, Balcraig, and Mr Robert S. Trotter, Perth.

The following were nominated:—Mr James Kennedy, schoolmaster, Ballinluig; and Mr Robert H. Meldrum, Cherryhank.

DONATIONS.

The following were announced:—*For Index Collection*—From Mr James Stewart, specimen of the vertebra of a bird, showing its structure, and a dissected toad; from Mr A. E. Pullar, stem of banana. *For Perthshire Collection*—From Colonel Drummond Hay, a number of geological specimens, illustrating the nature of a trap dyke going through red sandstone; from Mr William Lindsay, fifteen specimens of seedlings, from two to four years old, of native timber trees of Perthshire; from Mr Thomas Boston, Balmuick, Comrie, two specimens of the rough-legged buzzard—a decidedly rare Perthshire bird, shot at Comrie; from Sir Robert Menzies, Bart., a mute swan and two wild rabbits; from Mr James Barlas, two samples of rock from Hilton Quarry; from Mr Henderson, Dundee, a lump sucker fish and a cuttle fish; from Mr Herd, Scoonieburn, two field mice and fungus.

THE GILCHRIST LECTURES.

Dr Buchanan White stated that in accordance with a resolution passed by the Council he had written to the Secretary of the Gilchrist Trust to ascertain if it would be possible to have a course of lectures delivered under the auspices of the Trust in Perth next winter. As the trustees will not meet till June, no definite reply could be received till then, but the Secretary did not hold out much promise. However, as there was a fund in hand from the lectures that had been delivered in Perth under the auspices of the Literary and Antiquarian Society and the Perthshire Society of Natural Science during the past two winters, a proposal was at present under consideration to have another course next winter.

The following paper was read:—

"*How an Insect Flies.*" By Mr S. T. Ellison.

The power of flight, or aerial navigation, possessed by birds and insects, is certainly the most graceful, as it also appears to us to be the most easy mode of motion. The most careless and unobserving amongst us, as well as the most diligent lover and student of Nature, must at various times have been struck with the gyrations of some tiny insect. In the house the bluebottle may by its hum have attracted our attention; and if we have ever tried to catch it, we have no doubt formed a good opinion as to its power of flight. If the common house-fly has not gained our admiration by the facility with which it can transport itself from place to place, it has often, I venture to say, aroused our wrath by the persistency with which it will return to some facial spot or elevation from which it has repeatedly been driven. Outside, we have noticed some butterfly, as, with uncertain and wavering flight, it visits the cabbages in our gardens; and the busy bee may have given us a lesson in diligence as he flits buzzing from flower to flower. Or perchance, in our rambles, we have come across that most majestic of insect flyers, the dragon fly, as, like a racehorse, he has rushed past us, or like a swift, in his sweeping flight, he has wheeled round us, and have been compelled to stand and watch his graceful evolutions. We must, I say, have observed all these and many other of the common occurrences of everyday summer life, but have we ever stayed to enquire how this wonderful power is attained? In considering flight this evening, I shall have to limit myself to this power as possessed by insects, because I could not attempt in so short a time as I dare venture on your patience, to consider the many contrivances and arrangements which we find in the wings and construction of birds, and which it would have taken the whole of our time adequately to discuss; but in enquiring how an insect flies, we shall, I hope, gain a knowledge of flight in general, whether it be the flight of an insect, a bat, or a bird, for whatever is able to fly must fulfil those general laws by which this power becomes possible.

The subject of flight, I think, becomes very interesting when we consider that it is that kind of motion which man has hitherto been unable to imitate, though we can readily believe that he has from the earliest times longed to do so. Within the present century we see what advances man has made both in terrestrial locomotion and also in aquatic navigation;—the former with its railways in every direction, so that a few hours' travel will take us to the furthest limit of our little island, and the latter with its floating towns bound for every quarter of the globe. These are some of the triumphs of recent years, by which man on the land has been able to outstrip the fleetest and most enduring of the terrestrial animals; and on the sea has been enabled, by imitating the propelling power of the fish, to navigate his bark regardless of the winds upon which he formerly so much depended. When, however, we turn our attention to flight, we find that man has made little or no progress. That this power will someday be attained by man I think we have every reason to believe, but the possession of it will only be obtained by the knowledge and due observance of those principles by which insects and other flying creatures are enabled to ele-

vate and propel themselves in and through a medium of such tenuity.

We cannot, however, further pursue this aspect of our subject, but must proceed to discuss the practical question we have before us, and after we see the way Nature has endowed some of her subjects with the power to travel through the air, we may, in conclusion, again return to this most interesting aspect of our theme. Now, in considering flight, the first question which meets us, and at which we must necessarily glance, is the consideration of those general laws,—outside the volant animal,—which affect flight. The first force, then, which presents itself for our consideration is the force of gravitation, which exercises so great an influence on so many of the problems of life—a force which attracts an unsupported body to the earth with a fall of about 16 feet per second. The flying animal has then, first of all, to raise itself into the air with this force against it, and, when risen, it has to support itself against the downward tendency to which this force constantly subjects it. The second force which a bird or insect meets with and has to overcome is the resistance of the air, which, at a low velocity, is not very great, but which increases much more rapidly than the velocity increases, and which is very much augmented when a wind blows directly against the flying animal. These two forces then—viz., weight, and the resistance of the air—which at first sight seem so contrary to are nevertheless necessary to flight. Many seem to suppose the great essential to flight is lightness. This, however, is a common error. The balloon rises because it is lighter than the air, and thus escapes the grasp of gravitation, but the difference between a balloon and a flying animal is that the former is driven about by every wind, while the latter has a power residing in itself on account of its weight by which it is able to steer and regulate its course. All volant animals then possess weight, and are as heavy, bulk for bulk, as any other animals. Some may point to the air-cells and hollow bones in many birds, but it is now I think very generally believed that these add nothing to the capabilities of flight of these birds. The hollow bones are considered as being formed for strength, and the air-cells are such that the advantages they are supposed to confer are certainly not very great. Some believe that the air-sacs are adjuncts of the lungs, and assist in ærating the blood. That hollow bones are not necessary to flight I think is clearly proved by such splendid flying birds as the swifts, martins, and snipes having bones filled with marrow; and we find that large air-cells are possessed by other animals, such as the orang outang, whose powers of flight are certainly not very striking. A certain amount of weight, then, is necessary to flight;—it not only gives balance, but, as we shall presently see, it gives sustaining and elevating power, for when the flying animal has attained momentum its weight relieves the exertion falling upon the wings in attaining motion, and thus accounts for the prolonged flight of many insects and birds.

We now come to consider the wings of insects, and must first notice their construction. The wings or organs of flight of insects vary very much in form, strength, and opacity. Some insects possess two pairs and some only one pair; some are delicate transparent membranes, such as those of the common flies, dragon flies, bees, &c.; others are covered with minute hairs, such as in the caddis flies *(Phryganidæ)*, &c.; others, again, are opaque, and often of the most beautiful patterns and colours, as in the butterflies and moths. In some, such as the beetles, the front pair of wings are modified, being of a hard and horny nature, and serve as a sheath or cover for the hind pair of wings, but they still play an important part in flight. When we take up a wing, and, holding it between ourselves and the gas, look through it, whether it be the opaque wing of a butterfly or the transparent wing of a common fly, we notice that it is crossed by bars known to entomologists as nervures; and in some parts it is recrossed, or these bars are connected together by other bars which are termed nervules. These bars, when seen under the microscope, are usually found to be double tubes. Some have thought that one contained air, so as to give lightness, and the other contained a fluid, to give pliability to the wing;—others, again, have thought these tubes were connected with the respiratory system. Whether they have a twofold purpose or not we cannot tell, but that the main object is to give rigidity combined with elasticity to the wing is certain. If we examine a variety of wings, large and small, we shall find they are all built up after one general plan. You will notice that they are all strongest at the base or thoracic end of the wing, and along the anterior margin of the wing, getting finer and finer towards the posterior and outside margins. (Plate I., fig. 1.) The nervures are strongest in the beetles, where the body is heavy and the wings small, and decrease in strength and number as these conditions are receded from, until in some of the *Chalcidæ* no nervures are present. Another very important point is the conformation of the wing. If you pull one of the wings off a fly or bee, and hold it with the anterior margin on a level with the eye, you will notice that the wing possesses a twisted or screw-like surface; in fact, if you take one of the primary wing-feathers of a bird, you have in conformation an exact representation of an insect's wing.

The next point to consider is their attachment to the thorax. The wings are connected with the thorax of the insect by ball and socket, or, as they are termed, universal joints; so that the wing can oscillate or twist in any direction, and is capable of every variety of motion. If you have ever watched a fly dressing its wings, you will know how great is the extent to which it can twist them with the anterior margin both forwards and upwards, and backwards and downwards. The next point to notice is the muscular attachments of wings, and upon this I quote from Professor Pettigrew on "Animal Locomotion":—

The muscles are arranged in the form of a cross—*i e.*, there is a powerful vertical set which runs from above downwards, and a powerful antero-posterior set which runs from before backwards. There are likewise a few slender muscles which proceed in a more or less oblique direction. The antero-posterior and vertical sets of muscles are quite distinct, as are likewise the oblique muscles. Portions, however, of the vertical and oblique muscles terminate at the root of the wing in jelly-looking points which greatly resemble rudimentary tendons, so that I am inclined to believe that the vertical and oblique muscles exercise a direct influence on the movements of the wing. The shortening of the antero-posterior set of muscles (indirectly assisted by the oblique ones) elevates the dorsum of the thorax by causing its anterior extremity to approach its posterior extremity, and by causing the thorax to bulge out or expand laterally. This change in the thorax necessitates the descent of the wing. The shortening of the vertical set (aided by the oblique ones) has a precisely opposite effect, and necessitates its ascent. While the wing is ascending and descending the oblique muscles cause it to rotate on its long axis, the bipartite division of the wing at its root, the spiral configuration of the joint, and the arrangement of the elastic and other structures which connect the pinion with the body, together with the resistance it experiences from the air, conferring on it the various angles which characterise the down and up strokes.

Every entomologist is aware of the synchronism or duplicate action existing between the wings;—thus, if on attempting to set a specimen recently killed, the one wing is depressed or moved forward, a similar movement (though usually in a less degree) takes place with the other wing. This is on account of the movement of the dorsum of the thorax, which takes place as previously explained by Professor Pettigrew.

Having briefly referred to the construction of the wings of insects, we must now come to notice the various phases of the wing's action in the performance of its function as the elevator and propeller of the body of the insect. Now, the wing acts upon the air as a lever combined with a screw or rotating action. During the descent of the wing the body is elevated and propelled. At the termination of the down-stroke the body falls slightly, and this (aided by the muscles and the action of the air) gives the wing an upward impulse; but as the wings of most insects are vibrated so very quickly this fall is imperceptible; it is, however, to be clearly seen in those insects where the action of the wings is slow, such as the common white and brown butterflies. These insects, we observe, fly with a zig-zag, up-and-down movement,—the body rising and falling with every stroke of the wings, and giving them the uncertain and wavering motion so peculiar to all insects which vibrate their wings so slowly. I have referred to the rapidity of the wing movements of most insects;—let me give you a few particulars on this point, for I think it is one of the most wonderful of vital phenomena. Astronomers seem to delight to baffle us by rehearsing how many millions of miles separate us from some of the fixed stars, but I think we have in the vibrations of such an insignificant creature as a fly an equally puzzling reflection. Professor Marey, who has made elaborate investigations into the number of vibrations per second of the wings of various insects, gives the following list:—housefly, 330; dronefly, 240; bee, 190; wasp, 110; humming-bird moth, 72; dragonfly, 28; white butterfly (*Rapæ*), 9. If we watch one of these insects which vibrate the wings at a high speed, such as the housefly or bee, only a blurred impression is left upon the retina of the eye;—we cannot by sight observe their movements. If we could only see the root of the wing, we might be able to trace the various pulsations; but of course a slight movement at the root necessitates a corresponding movement at the extremity of the wing, which gains in speed according to the length of the pinion, for while the root is making a short movement, the tip of the wing has in the same period of time to pass over a much more extended range, and therefore must be greatly accelerated in speed. (Plate I., fig. 2.) Although the numbers that have been given may probably be looked upon as correct for ordinary flight, yet there is no doubt that these numbers can be and often are materially increased under different circumstances.

Professor Pettigrew gives many cases of insects still retaining the power of flight though large portions of their wings are detached, and I have myself many times repeated some of his experiments;—thus, the blue bottle-fly will still retain the power of flight though $\frac{2}{3}$ of the posterior margins of its wings are removed. The dragonfly, though it loses either its first or second pair of wings, is not disabled, but can pursue its airy flight with apparently little difficulty; and the butterfly, though robbed of its hind pair of wings, is not altogether

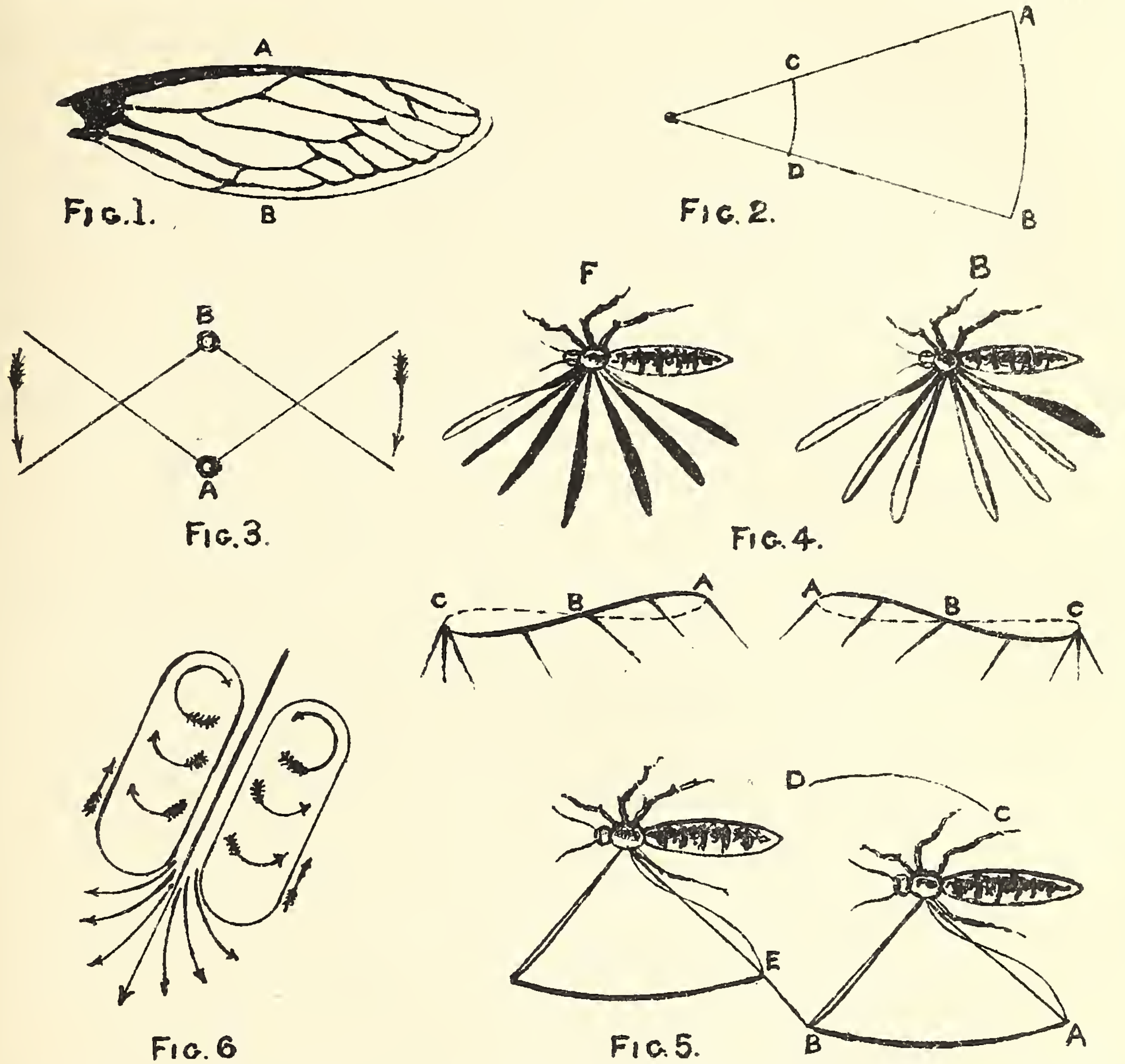


FIG. 1. A anterior margin B posterior do. FIG. 2. shews how wing increases in speed with its length passing from A to B in same time as it passes from C to D. FIG. 3. shews lever action of pinion the descent of the wings throwing the body from A to B. FIG. 4 F. forward stroke B. backward do. shews how during "stationary" flight the wing reverses its plane & describes figure of 8 curves: at A wing makes an angle of 45° which is decreased at B and changes its plane at C. FIG. 5. by the passage of the wing (obliquely) from A to B the body is thrown from C to D: owing to the momentum the insect has attained at D & also to the wing being met at B by the return current of air the wing rises from B to E and is ready for another depression. FIG. 6. shews currents created by descent of wing.

Figures 4 and 6 are taken from PETTIGREW on "Animal Locomotion".

deprived of this species of motion. We thus see that the wings of insects are in excess of their requirements, but in all cases the loss of surface has to be made up by increase of speed. This is proved by the sound emitted by certain insects. Thus if the blue-bottle, which during ordinary flight makes a loud humming sound, has a portion of the posterior margins of its wings cut off, the sound it then emits is heightened in tone, showing that for the loss it has sustained it must vibrate its wings at a more rapid rate. Now, in all the experiments I have so far noticed it has been from the posterior margins of the wings we have detached portions, and it is only with this posterior portion we can take so much liberty, for if much of the ends of the wings be removed flight becomes impossible; and if the anterior margin is only notched across the strong nervures in the centre or near the base of the wing, the power of flight is at once destroyed, which circumstance shows very clearly that it is the anterior margin which is most essential to flight; in fact, if anything happens to the anterior margin flight is altogether impaired. We can also deprive insects of this power by covering the posterior margins with a coating which hardens as it dries, thus destroying the flexibility of the wing.

The stroke of the wing in some insects is delivered in a vertical or down-and-up direction ; — in the majority, however, it is in an oblique or nearly horizontal direction;—but all insects can and must often change the direction of the stroke. Those having the vertical stroke are all ample winged,—the wings of those with the oblique stroke being long and narrow. Now, it is very easy to understand that a downward impulse of the wings will give an upward impulse to the body, for we know that reaction is always equal and opposite to action (plate 1, fig. 3) ; but the more difficult question presents itself when we endeavour to explain the propelling power. Borelli (a celebrated physiologist, who lived about 200 years ago, and was the first to carefully study the subject of flight), and all who follow his views, maintain that propulsion is effected by the wing striking the air, and causing it to rush with force in a backward direction; and in its passage under the wing, by bending the posterior margins upwards, it pushes the body forwards in an opposite direction. But experiment fails to prove this theory, for we cannot find that any current passes behind the wing in a backward direction, as we shall see when we come to notice the currents. I am, therefore, inclined to believe on this, as on other points, with Professor Pettigrew, that the propelling power is the result of the construction of the wings, and their application upon the air. The fact of the wing being concave above and convex below, its screw-like configuration, and the way in which it strikes upon the air with its ever-varying angles, all render it especially adapted for giving horizontal motion ; so that when the wings strike vertically downwards and forwards, part of the force is expended on elevation, and part goes to the propulsion of the insect. This is readily perceived if you get a bird's wing dried in an expanded position, or a large artificial wing constructed after the type of an insect's wing. If you depress or elevate it vigorously, you will feel how it at once darts forwards in a curve. Most of the insects that are remarkable for the rapidity of their flight vibrate their wings in an oblique direction, this stroke giving less elevating and greater propelling power, for when the wings strike forwards and downwards the body is at once thrown forwards and upwards. (Plate 1, fig. 5.) All who have spent any time watching a fly must often have been surprised by the apparently slight movement of the wings which is sufficient to launch it into space.

I now turn to the currents. All wings give their effective stroke in a forward direction or towards the head of the insect. Even the vertical stroke is delivered in a forward direction. When the wing is depressed (say vertically) in a forward direction, it uses the air under it as a fulcrum to obtain elevation and propulsion. During its course, however, it drives the air before it, greatly increasing the pressure below and decreasing it above the wing. It, in fact, destroys the equilibrium of the air, which rushes in at once from all sides towards the path of the wing, creating currents of air, which flow with circling motions towards this place of least pressure. (Plate 1, fig. 6.) If you depress the artificial wing to which I have referred before a gas jet, having the anterior margin next the flame, you will perceive that the flame is drawn towards the path of the wing; in other words, the wing induces a current at right angles to its path, which, as we shall hereafter see, it uses for its elevation. If you depress the wing with its posterior margin next the flame, the same thing occurs, and the flame is still drawn towards the path of the wing, which shows clearly I think that no current passes under the wing, or else the flame would be blown away from, instead of drawn towards, the wing.

Let us now pass on to the consideration of the path of the wing, and in this we shall find one of the greatest difficulties connected with wing movements—viz., the elevation of the pinion. When a downward impulse is communicated to the wings, we know that a corresponding upward impulse is communicated to the body

of the insect; but how is it that, during the upward movement of the wings, the converse does not take place, and the body become depressed to a like extent? In birds we find that during the down-stroke the wing presents its greatest surface so as to obtain greatest leverage, while for the up-stroke it is by its construction able to flex or draw in, so that during the up-stroke a much smaller surface is presented; and we further find that the feathers, by their construction and arrangement, form, during the down-stroke, an impervious barrier to the air, while during the up-stroke they separate, and the air passes through them as through a riddle. In the wing of the insect, however, no such arrangement is to be found, for the wings, being membraneous, are impervious to the air from either side. We shall, however, find, when we proceed further and trace the wing during the various phases of its evolution, that during the up as well as during the down-stroke elevating and propelling force is evolved. We must now endeavour to trace the wing throughout its course, and the more easily to obtain a thorough idea of this question, we will first of all notice what we may call—to use a Hibernian expression—stationary flight, or the motion of the wings of an insect which is held stationary, either by the hand or other means. The vibrations of the wings of an insect in this position form an elongated figure-of-8 track in space. (Plate 1, fig. 4.) At the commencement of the down or forward-stroke the wing makes a forward angle of about 45 degrees with the horizon. It attains its highest speed about the centre of the stroke, or when it is at right angles to the body. The angle which the wing makes with the horizon at this point is less than it was at the commencement, owing to the resistance it experiences from the air. After passing the centre, the wing begins to decrease its speed, and owing to the anterior margin being stiffer it slows sooner than the posterior margin. This latter portion, at the end of the stroke, owing to the motion which has been communicated to it, twists round the anterior margin, and thus causes the wing to reverse its plane, and it then makes a backward angle of about 45 degrees, and is ready for the up-stroke. We have previously seen that the wing during its forward or down-stroke induces a current of air at right angles to its path: it now utilises this current, and rises upon it like a kite upon the wind. At the termination of the up-stroke the posterior-margin again twists round the anterior, again changing the plane of the wing, which is then ready to repeat the down-stroke. Thus there is a continuous movement, the down merging into the up-stroke, and *vice versa*. It is by a short movement of this description that many insects are able to poise themselves in the air, the forward and backward strokes combining to give elevation but no propulsion. Many insects in this way rifle the corollas of flowers without alighting, and present the appearance, owing to the rapidity of their wing-movements, of being surrounded by a circle of motion. Those insects having ample wings and the vertical stroke cannot thus suspend themselves in space.

Let us now pass on to the consideration of progressive flight. In the case we have just considered, the insect was held firmly. If, however, we had released our hold, it would instantly have darted off, and in that case, instead of making figure-of-8 curves, it would have made a waved track by the vibrations of its wings,—the difference being that in the former case the body of the insect was stationary, while in the latter every vibration gives the body forward motion, and to carry the body forwards is equal to carrying the wings backwards. The wings, therefore, in progressive flight, always make a forward angle with the horizon, and instead of going upwards and backwards go upwards and forwards. (Plate 1, fig. 5.) All the movements, then, we have just noticed in regard to what we have termed stationary flight are repeated in progressive flight, with the exception that the wing never reverses its plane, for when it makes about a right angle with the horizon, it is seized by the current of air which it has by its down-stroke created, and, owing to the weight and forward travel of the body, the wing acts upon the air after the manner of a kite, and at once rises upwards and forwards upon this current, until it is again ready for a downward impulse. The momentum of the insect is the force by which the wing rises upon this current, just as the tension of the string is the force by which the kite mounts upon the wind. Thus, with the expenditure of a very trifling amount of force, the wing during its upward movement gives elevation as well as propulsion. Hitherto I have referred only to the power of horizontal flight, and all that need be said in regard to the endless gyrations performed by insects is that they are able to ascend, descend, or dart sideways as the case may be, either by the bending of the abdomen, thus displacing the centre of gravity by changing the plane of oscillation of the wings, or by the increase or diminution of the amplitude of the vibrations of the pinion.

The more we consider the wing and its movements the greater must be our admiration of its powers. It is, in fact, a perfect mechanical instrument. As each of the various portions of the wing throughout its length oscillates at a different speed, so the angles and

currents which each portion makes vary according to the velocity at which the pinion is driven. It is the perfection of the pinion in its application upon the air which has so far been the stumbling-block that has baffled imitation. Most of the attempts at flight which have hitherto been made have been in utter ignorance of, and therefore without any regard to, the principles adopted by Nature, and we can only hope that when these principles are more considered and better understood, the solution of this question of artificial flight may be obtained. The subject we have had in hand requires a good deal of consideration fully to appreciate, and I think one of the reasons of its apparent difficulty lies in the fact that we are all more or less liable to approach it with certain preconceived ideas, one of the most prevalent being that the effective stroke is delivered in a backward direction, whereas all wing-movements are characterised by the down or effective stroke being given in a forward direction.

In conclusion, though I cannot expect to have made this subject as interesting to you as I have myself found its consideration to be, nor dare I flatter myself that I have made it as explicit as might be desired, yet I do venture to hope that the few remarks I have made may prompt some to give a little more attention to this most interesting though complex subject, the complexity of which the wise King of Israel in his day fully realised when he said it was one of the things he knew not.

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## May 1st, 1884.

Dr F. Buchanan White, F.L.S., President, in the Chair.

NEW MEMBERS.

The following were elected:—Mr Robert Hunt Meldrum, Cherrybank, and Mr James Kennedy, Ballinluig.

DONATIONS.

The following were intimated :—

*Index Collection.* From Mr Alex. Wynd, Trinidad—scorpion and other specimens; Dr Gowans, Perth Infirmary—two sections of the skin of the Tay whale.

*Perthshire Collection.* From Mr Herd, Scoonieburn—red deer's horn from blue clay, Strathearn; Sir R. Menzies, Bart., Rannoch Lodge—long-tailed tit's nest and six eggs, two lizards, four crow's and four plover's eggs, one long-eared owl and eggs, and eggs of tawny owl; Mr Laidlaw, Castle Menzies—one golden plover, two hooded crows, two carrion crows, a teal drake, and a sparrow hawk; Mr M'Donald, Rannoch Lodge—four eggs of the common heron, a male goosander, a coot, and a field vole; Mr Herd, Scoonieburn—two field mice; Col. Ogilvy, Rannagulzion—hooded crow; Captain D. M. Smythe, Methven Castle—two gull's nests and four eggs; Colonel Drummond Hay of Seggieden—wild duck's nest and eggs, starling's nest and eggs, and one newt; Mr J. M'Lean, Almondbank—a rat; and Mr James Coates, Pitcullen—a linnet.

EXHIBITS.

Dr Buchanan White exhibited catkins of a species of willow (*Salix fragilis*) showing an unusual formation. In the willows the flowers with stamens occur on one plant, and those with pistils on another, but in the specimens in question both stamens and pistils occurred in the same catkin. The pistils were few in number, and were chiefly to be found towards the base of the catkin. This abnormality, though apparently not frequent, is not altogether unknown, at least in some other species of the genus. Plants of *Salix pentandra* which exhibited the phenomenon were described as a distinct species — *S. hermaphrodita* L.; and though its occurrence in *S. fragilis* is not mentioned by any of the authors consulted, yet as Grenier and Godron say in the *Flore de France* that it has been found in other species than *S. pentandra*, it seems probable that it may have been noticed in *S. fragilis* before. Another peculiarity of some of the catkins of the tree from which these were taken (which grows in the Woody Island) is that they show a tendency to bifurcation.

The following paper was read :—

"*Fruit Culture, and some of the Hindrances to its more General Cultivation.*" By Dr Robertson, Errol.

Since I last had the pleasure of addressing you on the cultivation of fruit, a great interest has been aroused in the subject, and a great impetus given to its advancement, by the Apple Congress, held in October last, in the Royal Horticultural Gardens, Chiswick, near London. It was a truly grand affair, nothing of the kind having been held before, and far exceeded the most sanguine anticipations of its promoters. Such an exhibition was much required, as our pomological nomenclature was very deficient and incorrect, every district having local names of its own, and

hence the difficulty of making a selection of really good apples. It was also much required to enable us to know the kinds that are really worth cultivating, and the kinds that, as regards size and quality, are not worth a place in either orchard or garden. Something of the kind was also greatly needed in order to show the general community that really good fruit can be grown in this country, if it only gets the attention it deserves.

The cultivation of fruit in this country, especially in Scotland, has been sadly neglected of late. In the Carse of Gowrie, as well as elsewhere, many good orchards have been allowed to run to waste. There has been a great outcry as to bad seasons, and not without good cause, but bad culture has, I fear, as much to do with it as bad seasons, or, I should rather say, the want of culture. Many of the Carse orchards had no digging, no pruning, and no manuring, and yet, under such treatment, fruit was expected. In many of the largest orchards in the Carse, all the trees were completely covered with moss, and the soil exhausted by wild grass and weeds. In October last, I had good opportunities of seeing many of the Carse orchards, as I was asked by the Secretary of the Dundee Horticultural Society to gather all the specimens of apples I could find, for the Apple Congress at Chiswick. I also visited many of the gardens, and most of the good specimens I got were from these, clearly proving what I have always advocated, that good culture is the great secret of successful fruit-growing. The duty of collecting so many different specimens in so many gardens and orchards entailed on me a good deal of labour, but I sometimes managed to "kill two dogs with one stone," by visiting a patient or two at the same time. It was, however, very interesting and pleasant work, as it gave me an opportunity of seeing many orchards and gardens, and that at the most interesting season of the year. I must say that all with whom I came in contact—even those who had rented orchards—gave me freely all the specimens I wanted, and all the information in their power, when I told them the purpose for which I wanted them. I think I sent to the Congress the largest collection that was sent from Perthshire. I had over sixty varieties, some of which were very beautiful, and large in size. Some of them were from my own gardens, but by far the greater number were collected as already stated. One or two of the finest specimens which were specially noticed for their beauty were from A. Lacaille, Esq., Gourdiehill. The "Lass o' Gowrie" was particularly fine. One thing I particularly noticed in going through many of the orchards was the enormous number of apples of small size, which were quite unfit for market, and had no names, or merely local names. Many of these were just crabs or wild apples, not even having colour, as many of the American crabs have, to recommend them. The only crab apple I saw with any pretensions to beauty or symmetry of form was in the U.P. Manse garden, Pitrodie—a beautiful little round one of a fine golden colour, tinted with red. I was truly sorry to see so many large orchards in the Carse with so very few of the large kinds,—apples that are really worth being sent to market, and likely to be able to compete with those brought from the Continent and from America. On the Continent, as well as in America, a great deal more attention is paid to fruit culture. The apples from Germany, as a rule, are of a larger kind, and higher in colour, than what we grow in Scotland, or even Great Britain, and hence the price they command in our markets.

To remedy these defects as far as possible, and having the writing of this paper in view, I sent out a schedule of four questions to almost all the head-gardeners in the Carse, and some of the most experienced market-gardeners and orchard-keepers, asking what apples and pears grown at present in the Carse orchards are unworthy of being cultivated on account of smallness, bad quality, or bad bearing. Also, what kinds they would substitute in the place of the bad ones, as more suitable for market and home consumption,—at the same time asking them to make what remarks they thought proper on the subject. I did this with the view of laying before the members of this Society, and the general public, a synopsis of the pomological lore of the Carse in the shape of a list of the apples and pears that are really worth cultivating, as being fit either for market or home consumption, and able to cope with foreign importations. Almost all my horticultural friends duly returned the schedules filled up to the best of their knowledge, and some of them with very extensive remarks, and I take this opportunity of heartily thanking one and all who did so. From the returns sent me, I learn that a great many apples and pears in the Carse that are not worth cultivating have only local names, and many of them no names at all; and the kinds that are really worth cultivating are not very numerous, notwithstanding the vast number of varieties that are grown throughout the length and breadth of the land. At the Apple Congress there were about 1800 varieties exhibited, of every size, colour, and form, all of which were very pretty, though some were more objects of curiosity than of commercial and domestic value.

Some faint-hearted fruit-growers are afraid that fruit cultivation is being overdone, and that, by and bye, prices will not be got sufficient to pay the growing; but let me tell such that, year after year, the demand in this country

for fruit of all kinds is increasing, and yet there is not half enough of it used. I long to see the time when every working man in this country will have his barrel of apples, as well as his potato store, and when every working woman will be able to cook them in various way as an article of diet. Instead of tea, so common now with our agricultural labourers, and I believe with many of our urban population as well, how much better would it be at dinner time to have even a few well-cooked potatoes with good milk, and a few stewed apples for dessert;—better both for their health and their purse. There is not nearly enough of fruit used in this country as an article of diet. In France, they use very much less butcher-meat than we do, and a great deal more fruit. The latter is seen almost at every meal. In America, also, a great deal more is used than in this country. I am happy, however, to see, by the statistics of the country, that the demand for fruit is gradually, though slowly, increasing. Our supply is also increasing, but not nearly fast enough, when we consider the enormous sums we pay for fruit imported from other countries, a great part of which we might raise ourselves, if more attention were paid to its cultivation.

I am happy to learn that fruit cultivation is now beginning to extend in Great Britain. In Gloucestershire, Lord Sudeley is setting a noble example. At Toddington, he has already 500 acres under fruit, and is about to plant 200 more. He has planted 3000 apple trees of the best sorts, 812 pear trees, 32,000 plum trees of 44 different sorts, about 9000 damsons, and 522 cherry trees; and between the trees he plants gooseberries, currants, rasps, and strawberries. Besides using the ground in this way, he has over 50 acres of black currants, raspberries, and strawberries by themselves. There are 100 acres of strawberry plants in all, and 60 acres of raspberry canes. Apple trees are grown as pyramids, a few as bushes, and the rest as standards. Gooseberry bushes number no less than 130,000, representing 45 varieties; and it may interest some here to know that for the main crop Warrington, Lancashire Lad, Whitesmith, Lancashire Prize, and Cram Bob are the chief ones. Of black currants there are no less than 228,000 bushes, chiefly Lee's Prolific, Baldwin's Black, Black Naples, and Prince of Wales. Raspberries are chiefly Carter's Falstaff, and the red currants Robey Castle and Scotch Red. Some may suppose that where so many trees and bushes are planted, a great many will be apt to go back; but where a little attention is given this is not the case. Among his 40,000 plum and damson trees, not 5 in 1000 have gone wrong.

After hearing of such extensive fruit-growing as that of Lord Sudeley's, some may suppose that the thing will be overdone in a very short time; but, so long as we pay so much for foreign fruit, which, with a little attention, we might raise ourselves, there is no cause to fear. Just think for a moment of the enormous sum of over £2,000,000 which we paid for foreign fruit in 1882. It would be very much better for us as a nation to raise as much fruit as we can, and keep as much as possible of that £2,000,000 at home. I am delighted, however, to think that public attention is being aroused on this subject. Already, even in the Carse of Gowrie, more attention is being given to it. Some have begun to improve their orchards and gardens, and are giving more attention to small fruit. One enterprising landlord, to the east of Errol, is this season planting over a dozen of acres of small fruit; and another, a little to the west of the village, has already planted part of a very large field (over a dozen of acres), which is to be wholly devoted to the same purpose; and it is to be hoped that others will follow their example. If only some enterprising individual or firm would start a jam and jelly work in the Carse capital (Errol), we believe more fruit would be grown in the Carse. Mr Charles Whitehead, a great authority on this subject, says that he "is glad to learn that Cambridgeshire must now be included among the fruit-growing counties. In the neighbourhood of Wisbeach a large quantity of fruit is grown, and the gooseberry crop in 1883 fetched £75 per acre, and in 1882 the same crop realised nearly £100 per acre."

While speaking of gooseberries let me tell you something more of what we can do nearer home. Shortly after reading my last paper to you on fruit, I received a note from a gentleman in the legal profession (I am not at liberty to mention his name) who cultivates a large piece of ground in growing gooseberries, I believe as a speculation. In his letter he says he has 7000 gooseberry bushes, which in one year yielded £205. In 1881, from 1700 bushes, he had an average of 2s per bush, and some of them were by no means large. This should be encouraging to fruit-growers, but let me give you one or two more examples. Only a few weeks ago, I was discussing the fruit trade with a traveller for a Dundee nursery firm, and, in speaking of gooseberries, he told me he was lately in a market garden near Forfar, and saw the gardener there get from a customer 3s 6d for fruit off one bush. A gardener about a mile from Errol told me that from one bush he sold last year 6s worth. It was the kind called "Langley Green." While speaking of gooseberries, allow me to give amateurs a hint how to economise space. If you grow your bushes in the usual way,

in a clump, from 4 to 5 feet apart, and with the same distance between the rows, you can grow a standard gooseberry or currant between every bush in your rows, and in that way you could plant them double thick, as a gardener would say, and still have sufficient room for sun and air. Only a little more manure is required, there being more roots to feed. Now, I am sorry to say, that such a thing as a standard gooseberry is not to be had from the nursery, but you can raise them for yourselves, in the following way. In the spring select from the kinds you wish to raise a piece of last year's growth,—the longest piece of white wood you can get; pick out all the buds, except two or three at the top; put it 5 or 6 inches in the ground, and let it grow straight up, and when it is as tall as you wish,—say from 4 to 5 feet,—take off all the branches the following spring except three or four, which allow to grow into a head. Another plan is to graft one gooseberry stock upon another, till you get the required height. I have them growing in my own garden, raised in both ways, and they do remarkably well. You can have red and white currants raised in the same way, and they are really beautiful objects in the garden, not to speak of their usefulness. Even in a lawn or grass border they are as ornamental as the finest standard roses.

Having said this much about small fruit, let us now pass on to the selection of apples and pears by the Carse authorities on the subject. In the apple-voting there were 19 voters in all — 14 head-gardeners and 5 market-gardeners and orchard-keepers, — all men of great experience in fruit-growing as well as fruit-packing and selling. A few of the gardeners have had from forty to fifty years' experience, and some of the orchard-keepers have had from 5 to 20 of the principal Carse orchards under their care. I will now give you the result, which I trust will be useful not only to growers of fruit in the Carse but also elsewhere, in making a good selection for either garden or orchard :—

*Apples.*—Lord Suffield, 18; Keswick Codling, 15; Tower of Glammis, 16; Stirling Castle, 15; King Pippin, 12; Hill's Seedling, 12; New Hawthornden, 12; Dumelow's Seedling, 11; Warner's King, 11; Irish Peach, 10; Yorkshire Green, 9; Lord Dunmore, 9; Philip's Seedling (Cellini), 9; Lass o' Gowrie, 8; Kentish Codling, 7; Nonsuch, 7; Early Red Margaret, 7; Monk's Codling, 6; Arbroath Oslin, 6; Ribston Pippin, 5; Kerry Pippin, 5; Irish Green, 6; Grey Leadingtou, 3; Golden Pippin, 4; Ecclinville Seedling, 6; Cambusnethan Pippin, 5; Blenheim Pippin, 4; Revelstone Pippin, 6; Ringer, 4; Strawberry Late, 4; French Red Streak 4; Baldwin, 3; Cox's Orange 3; Eve Apple, 3; Fulwood, 3; Fair Maid of France, 3; Lord Derby, 3; Northern Spy, 3; Paradise Pippin, 3; Strawberry Early, 3; Wallace Cluster, 3; White Captain, 3; Standard, 3; Rock, 3; Alfriston, 2; Adam's Pearmain, 2; Astrachan Red, 2; Astrachan White, 2; Bedfordshire Foundling, 2; Baxter's Pearmain, 2; Beauty of Kent, 2; Blenheim Orange, 2; Dutch Codling, 2; Irish Codling, 2; Cornish Gilliflower, 2; Claygate Pearmain, 2; Devonshire Quarrenden, 2; Early Julien, 2; Emperor Alexander, 2; Fillbasket, 2; Green Sweet or Colville, 2; Grenadier, 2; Reinette du Canada, 2; Maiden, 2; Norfolk Bearer, 2; Orange Pippin, 2; Pot's Seedling, 2; Wadhurst Pippin, 2; Woodstock, 2; Betty Geeson, Clovelle Malingre, Cockle Pippin, Carlisle Codling, Dutch Mignonne, Fearn's Pippin, Jolly Beggar, Jenny Lind, Little John, Leyden Pippin, Margil Nelson's Glory, Norfolk Beaufin, Northern Greening, Pearson's Plate, Rymer, Royal Russet, Ingestre, Sam Young, Small's Incomparable, Striped Beaufin, Summer Thorle, Waltham Abbey, Winter Greening, William's Favourite, Yorkshire Beauty, Green Stoup, Painted Lady, Ashmead's Kernel Impd., Annie Elizabeth, Lady Henniker, and Winter Pearmain, all 1 vote each.

By these 19 voters, about 100 kinds have been voted in as good, and deserving to be cultivated. Most of the kinds I had the pleasure of seeing last autumn and can bear testimony to the care with which they have been selected. Some of them are not so well known as they should be, or they would have got more votes. I might instance the Lass o' Gowrie, which, although pretty high up in numbers, should have been further up, as it is one of the best early apples we have. Then there are Annie Elizabeth, Lord Derby, Emperor Alexander, Lady Henniker, and Waltham Abbey, all really first-class apples, which would be more cultivated were they better known. Lord Suffield, which is highest in the list, well deserves the place it occupies, as it is a free grower and free bearer, with a hardy and beautiful bloom. The trees are not liable to canker, and can be grown almost to any size wanted, and it thrives as well on the crab as on the paradise stock. I know an amateur, about half-a-mile from Errol, who had them the other year 17½oz. on a tree grafted by a working man, and on a crab stock from the woods. It is also encouraging to amateurs to know that this Lord Suffield apple was raised by a working man—a handloom weaver at Rhodes, near Manchester. While I am still on the subject of apples, I must not omit to mention another new apple, raised by a botanical friend of my own, the late John Brown, of Murie Gardens, It was exhibited for the first time at the Dundee Show last autumn by his son, the present gardener of Taybank, Errol, and took the first prize for table apples in the gardener class. They were decidedly the best in the show, and yet, strange to say, they escaped notice in the *Fruit Review*.

I now pass on to the pear voting. For pears only 17 voted, — 14 gardeners and 3 orchard-keepers, — and the result is as under :—

Hazel or Bram Beurrie, 14; Crawford, 11; Swan Egg, 9; Gal-

ston or Moorfowl Egg, 8; William's Bon Chretien, 7; Craig's Favourite, 7; Beurre d' Amanlis, 6; Jargonelle, 6; Marie Louise, 5; Benvie, 5; Beurre Diel, 5; Beurre Easter, 4; Beurre de Capiaumont, 3; Autumn Bergamot, 3; Dutch Bergamot, 3; Flemish Beauty, 3; Grey Honey, 3; Josephine de Malines, 3; Citron des Carmes, 2; Croft Castle, 2; Black Achan, 2; Beurre Rance, 2; Broom Park, 2; Green Chisel, 3; Hacon's Incomparable, 2; Louise Bonne of Jersey, 2; Longueville, 2; Souvenir du Congress, 2; Passe Colmar, 2; Napoleon, 2; Nondescript, 2; Beurre Bachelier, Bergamot d'Esperin, Bishop's Thumb, Beurre White, Black Pear, Catillac, Colmar, Eté, Cripple Fiddler, Beurre d'Arcmberg, Beurre d'Assumption, Clapp's Favourite, Duchesse d'Angouleme, Drummond, Duncan, Summer, Doyenné d'Eté, Glout Morceau, General Todleben, Green Yair, Jersey Gratioli, Huntingdon Early, Madame Treyve, Marechal de la Cour, Pitmaston Duchess, Suffolk Thorn, Thomson's Pear, Winter Nellis, Yat, Aston, Town, and Uvedale's St Gemain, all 1 each.

The last named has been known to grow 3lb. in weight. While still speaking about pears, let me give you a list of some I had the pleasure of seeing growing in pots this last season, and their weight when taken off:—Doyenné de Comrie, 17oz.; Beurre Bacheleir, 14 oz.; B. Diel, 15oz.; Fondante d'Automne, 1lb.; General Todlehen, 13oz.; Glout Morceau, 12oz.; and Nouvelle Fulvie, 14oz. All the above were in one little glasshouse, but with no artificial heat. The following is a list from another garden, also grown under glass:—Lieutenant Potiven, 16½oz.; Duchesse d'Angoleme, 12½oz.; Pitmaston Duchess, 13oz.; Madame Treyve, 10½oz.; General Todlehen, 14oz.; Marechal de la Cour, 15½oz.; and Soldat d'Esperin, 12½oz. This will give you some idea of the size of pears that can be raised in pots, under favourable circumstances, and when well attended to. You must not go away with the idea that because these fruits were grown under the shelter of a glasshouse, they cannot be grown almost as well outside. If grown in pots, and liberally treated and placed in a sheltered situation, they will grow to an immense size. You will perhaps be surprised when I tell you that I saw some of the same pears I have already named grown in another garden under glass, but with no artificial heat, some of them in 9-inch pots, with from 6 to 18 large pears, from 12oz. to a pound in weight. The finest coloured and largest King Pippin apples I met with last season were grown in a pot at the front-door of Mr Wilson's house, Cuba Terrace, in the village of Errol. I had the pleasure of exhibiting them at a lecture I delivered in Kinnaird in February last on cottage-gardening; and they were so highly coloured that some of the audience took them for oranges. Through the kindness of Mr Tait, builder, Errol, I am able to show you some of the same as exhibited on that occasion.

I will now give some hints on fruit-growing for the benefit of my fellow-amateurs. A good deal depends on pruning. Don't have too many branches on your trees, and have them as open in the centre as possible to allow sun and air to all the fruit, as this is the secret of colour and flavour. Root-pruning is also sometimes as necessary as branch or spur pruning. I know some gardeners in the Carse, noted for their success in fruit-growing, who lift their trees, when not too large, every third or fourth year. When they get too healthy, and grow all to leaves and branches, this checks the growth, and makes them grow fruit-buds instead. For the benefit of those who may have some old trees in their gardens or orchards that are somewhat barren, let me give the following instance of what root-pruning does. When but a very young lad, I recollect hearing my father, who was a keen amateur-gardener like myself, talking with a working-man who had a small orchard attached to his garden, which bore no fruit. He, therefore, implored his landlord, who was a farmer, to allow him to dig the trees out, as potatoes and cabbages would be better than no fruit; but, as the farmer was only a tenant, this leave he could not grant. He then dug deeply round the roots of all the trees, breaking all the long bare thongs—the tent-poles, as some call them—and felt perfectly sure that, so soon as the leaves were out, the first good breeze would blow every tree down. What was the result? Next autumn they were so laden with fruit, that all the ropes, and props, and sticks that could be had were in requisition to keep them from being split up with the weight. Now this was the result of root-pruning, although the man at the time did not know the good he was doing; neither did I when I heard the story first, but I know it now, and tell it for the benefit of others.

I now pass on to another process in fruit-culture, and this, perhaps, the most important of all, viz., manuring. In fact, this is the secret of large gooseberries, large apples, large pears, and large fruit of all kinds. Let me give you a case in point. A few months ago my attention was arrested by an enormous cauliflower in a seed-shop window; and to my astonishment I found it was grown by a friend of my own in the teaching profession. A few weeks after this I happened to call on my suburban friend when his day's work was over, and found him carrying from a barrel sunk outside his pigstye the liquid manure to his cauliflower. This was the secret of his big cauliflower. Let me advise you also not to lose a drop of your soap suds, as they are excellent manure. In our washing-house at Errol they are all

collected in a barrel, and when cold they are carried to my trees, bushes, and vines. I have also my dunghill drained, so that the liquid manure is collected in a barrel outside, and afterwards used to fertilise the flowers and fruit. Nature is a splendid economiser, if mankind would only study her laws and assist her. Near to a great many cottages in the country, I see pig-styes, with the liquid manure running all to waste, which, if carefully economised, would be invaluable for the garden. Is it not something worth knowing, that by a little attention to a few sanitary rules, what would produce deadly and infectious diseases, may be made to produce life-sustaining food and lovely flowers. Nothing need be lost,—not even the smoke of your chimneys, which is the product of the sun's rays of past ages. Horticulturists tell us that there is nothing better for roses than sooty water; so keep all your soot, tie it in a thin bag, and put it in a barrel of soft water; let it stand for some time, and afterwards carry it to your trees and bushes.

I now pass on to the next part of my paper, namely, some of the hindrances to the more general cultivation of fruit. Hitherto our Land Laws have greatly retarded the advance of fruit culture. I have been told that in France, where fruit is more generally cultivated than in this country, many of the houses in the country districts have from a quarter to an acre of ground or more attached to them, where fruit is extensively grown. Here such a thing is the exception, and not the rule. When the ground is owned by the occupant, there is a greater incentive to the cultivation of fruit, or any other industry that will pay; but when a tenant has only his house and garden from year to year, or even on a short lease, with no chance of remuneration for substantial improvements at its expiry, his best efforts are paralysed. Dr Robertson concluded by pointing out some of the other hindrances to the more general cultivation of fruit, such as the difficulty of obtaining land at a cheap rate, and the want of a proper knowledge of the subject by the great mass of the people.

Dr Buchanan White, in moving a vote of thanks to Dr Robertson for his paper, remarked that the Society was very glad to receive it although it was a little beyond their subject, and was more a part of applied science than of science pure and simple; still he did not think they were any the worse of having papers of that kind occasionally, especially when they were so very practical and valuable as the one they had heard that night, which went to the root of the matter.

Mr A. Coates, in seconding the motion, said that the subject was one of deep interest both to the members of the Society and the public at large, and he hoped that the publication of the paper would widely extend the knowledge of the subject, and increase the interest taken in it, also that it would cause much more attention to be given to fruit-cultivation than had hitherto been done. It was becoming a matter every day of more and more importance that we should devote our attention to the cultivation of fruit in this country, as our agricultural interests were being every day more handicapped by foreign competition in the matter of grain. It was, however, not only a simple money question, but also one of health. He thought every one would admit that we used far too little fruit in this country, and that a larger use of it would be conducive to the public health generally. The effect of the paper no doubt would be to increase the interest of the public in the Society by showing them they could not only devote themselves to the study of science, but could bring it home in such a way as to make it very much to the interest of all parties to combine with them in their efforts to promote the study of natural science.

In reply to a question, Dr Robertson said that we had a good deal to battle with in this country in regard to climate, but with cultural care, and a good selection, we could overcome these difficulties to a considerable extent. Often very fine fruits could be grown very well in sheltered situations.

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## SUMMER SESSION, 1884.

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The following Excursions were made :—

May 10th.

1. *To Craighall.*

Craighall, the property of General Clerk-Rattray (by whose kind permission the Society was allowed to make an excursion there), is admitted to be, in great measure, the original of Sir Walter Scott's Tullyveolan, and hence has an additional interest added to its charms. As it is so well known (for, by the liberality of its proprietor, the

public are allowed free access to the grounds twice a-week during summer), we need not attempt a description of its romantic scenery. But we may mention that it has long been celebrated as a place rich in rare and interesting plants. The most noteworthy of these is the whorled-leaved Solomon's Seal *(Polygonatum verticillatum)*, a plant which in Britain occurs only in Perthshire and Northumberland, and which in Perthshire has its head-quarters at Craighall and its neighbourhood.

Owing to the backwardness of the season vegetation was not quite so far advanced as was hoped, and consequently not so many "finds" were made as would otherwise have been the case. The above mentioned Solomon's Seal was pointed out, but was only a few inches high. The next most interesting species was the curious Toothwort *(Lathræa squamaria)*, a pale brownish-white plant, which is parasitic on the roots of trees, and which gets its name from the scales which clothe the underground stems. The plant has no leaves, and the flowers are the same colour as the stem. Craighall is probably the most northern place in Britain where it grows. These were the only really rare plants that were found, but a number of other interesting species were seen.

Botany was not, however, the only study of the party. The zoologists and geologists also found objects of interest to them. To the former the best "find" was a beautiful little land-mollusk *(Helix lamellata)* hitherto found in very few spots in Perthshire, and not previously known to occur in this locality. The geologists used their hammers to some purpose, for though the rocks of Craighall are conglomerate, yet various "travelled boulders" occur here and there. Conspicuous amongst these is the "Muckle Stane of Glen Balloch" (celebrated in song by the worthy Secretary of the Society), to which some of the party paid a special visit. Apart from its interest as a "boulder," this stone exhibits some of these curious and puzzling sculptures known as "cups." It may be mentioned that the party took the opportunity of seeing the golden eagle lately shot at Dalnabreck in Strathardle, and which is being stuffed in Blairgowrie.

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### May 22nd.

2. *To Kincardine Glen.*

Kincardine Glen is a narrow valley on the northern flanks of the Ochils, through which the Ruthven water flows, and the little bit of it which can be seen from the high viaduct which crosses it near its mouth is much admired by travellers on the Caledonian Railway between Perth and Stirling. The valley is excavated out of the Old Red Sandstone (which is here not red, however, but yellow and grey), but except in a few places the rock is not visible, though the sides of the glen are very steep. At several points the sandstone is interrupted by "dykes" of trap rock, which are of much later origin than the sandstone, having come up in a molten state through fissures. These dykes make more or less conspicuous features on the sides of the glen, and break the monotony of the sandstone. Not that the scenery of the glen is monotonous. It is far from that. The river takes a winding course, and its banks here and there form little meadows dotted with stately spruce and silver firs. At other points the banks rise steeply on each side of the water; and throughout the glen the steep sides are clothed with various kinds of trees. At this season of the year the valley is very lovely. The tender and varied green of the oaks, birches, and other trees which are just bursting into leaf, are intensified by the more sombre colours of the firs. Here and there a bird-cherry or a gean stand forth arrayed in all the beauty of their snow-white blossoms, while beneath the trees the ground is carpeted with many a bright-coloured flower — purple orchids, pale yellow primroses, golden marsh marigolds and celandines, and silvery anemones and wood-sorrel; while less conspicuous but equally beautiful plants reveal their charms to the keen eyes of the botanists. But the beauties of the glen are not confined to still life. Burns dashing down in many a merry cataract to mingle their waters with the Ruthven;—birds of many a kind flying from tree to tree, or pouring forth their melody from the depths of the woods;—butterflies and bees flitting from flower to flower; and silver-sided trout gliding through the pools, each and all give additional charm to the scene. These can all be appreciated and enjoyed by every one, but to the naturalist, whose privilege it is to see more than uninstructed eyes can see, the appreciation is deeper, the enjoyment greater. It is true that he can penetrate but a very little way behind the veil, but even that little adds vastly to the charms of a country ramble.

The most notable "find" of the day is more remarkable for its rarity than for its size, being a very small moss that grows upon damp sandstone rocks. This moss has a special interest for Perthshire botanists, since it was first discovered—about the beginning of the century—in Dupplin Den (where it is yet to be found) by George Don, who was for some time gardener at Dupplin, and who discovered many of the rarest Scottish plants. It had not previously been found in (or at least reported from) Kincardine

Glen, though it has been found in a few other places since its first discovery. The moss was named in honour of its discoverer, and is now known as *Anodus Donianus*. Amongst the other plants observed were *Veronica montana*, a local and rare Perthshire plant, but one which grows in this glen in great profusion; *Neottia nidus-avis*, a curious pale-brown orchid; *Paris quadrifolia; Botrychium lunaria ; Caltha palustris* var. *Guerangerii ; Stellaria nemorum ; Cardamine amara ; Chrysosplenium alternifolium ; Epilobium angustifolium* var. *brachycarpum ; Morchella esculenta; Dædalea quercina; Uredo confluens; Synchitrium mercurialis*, &c., &c. A number of insects and shells were also observed, but not of sufficient rarity to demand special notice.

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### May 31st.

3. *To Aberfeldy, Castle Menzies, and Weem.*

Going by train to Aberfeldy, the party crossed the Tay, and explored its north bank for a mile or two. Though nothing very remarkable was found here, yet there was a sufficient abundance of plants in flower to make the walk a pleasant one. The most interesting botanical feature was the immense profusion in which an introduced plant, a perennial Lupin with blue flowers (probably *Lupinus perennis*), grew on an island in the Tay. (Another island below Aberfeldy was also noticed to be covered with it.) This Lupin has been known to grow here for more than 30 years, and has spread down the river as far, at least, as Kinclaven. It has also established itself by the side of rivers in Kincardineshire, Aberdeenshire, and Inverness-shire, so that it has now a claim to be included as a well-established plant in the British Flora. At Aberfeldy it covers spaces 200 or 300 yards long by 20 broad, and being at present in full flower, presents a striking appearance.

After exploring the river-bank for some distance, the party turned northwards towards Castle Menzies. In a small marsh opposite Weem the best "find" of the day was made. This was the Bladder Sedge (*Carex vesicaria*), which has been found in very few localities in Perthshire. Several good patches of it occur in this marsh. Along the approach to Castle Menzies the local *Veronica montana* was found to be common. After spending a little time looking at the interesting old Castle, the rocks on the hill above it were examined, but nothing strikingly rare was discovered. The beautiful view of Loch Tay was, however, sufficient reward to those who ascended the hill. Descending by the pleasantly-situated Weem Hotel, the party returned to Aberfeldy. The thanks of the Society are due to Sir Robert Menzies, not only for his kindness in giving permission to explore the ground, but also for providing guides, who were most attentive to the party.

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### June 14th.

4. *To Abercairny.*

In this excursion, by the kind permission of Mr Drummond Moray, the woods of Abercairny were explored. From the general appearance of these woods it was expected that they might prove to be rich botanical ground, but the result of the examination on Saturday shows that, though not altogether destitute of local plants, on the whole the flora is not particularly interesting. This is probably due to the dryness of the woods, and to the luxuriance of the trees. Amongst the rarer plants observed were *Carex disticha, C. sylvatica, Chrysosplenium alternifolium, Veronica anagallis, Stellaria nemorum,* &c. A pretty white variety of the Red Campion (*Lychnis diurna*) was also noticed. A few insects were captured, the most interesting being a variety of *Eulia ministrana*.

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### June 28th.

5. *To Ben Chonzie.*

This excursion was well attended, some members coming from a considerable distance to take part in it. Ben Chonzie (pronounced *Chohnee*, the *ch* being sounded as in *loch*) is a high mountain near the head of Glen Turret, and has a good reputation as a locality for alpine plants. The

botany of the Glen Turret side of it is pretty well known, but as the Glenalmond side bad not been sufficiently explored, and as, moreover, this lies in a different botanical district, it was determined to ascend the bill from tbat side.

Leaving Pertb at 7.30 A.M., tbe party drove by way of the Small Glen to Auchnafree, after which the journey was continued on foot. Near Buchanty, specimens were obtained of a rather interesting plant, the Master-wort *(Imperatoria* or *Peucedanum ostruthium),* which is, however, not indigenous, but the relic of former cultivation for culinary and medicinal purposes. Its name of "Masterwort," and also of "*Imperatoria*," was given to it on account of its supposed great virtues, but as it is not cultivated now, it is probable tbat these were more imaginary than real.

A few miles beyond Auchnafree the ascent of the hill was commenced, and alpine plants soon made tbeir appearance. Amongst tbese were *Saxifraga stellaris*, *S. oppositifolia*, *S. aizoides*, *S. hypnoides*, *Alchemilla alpina*, *Oxyria reniformis*, and *Asplenium viride*. At about 2000 ft. elevation, acres of the Cloud-berry or Averon *(Rubus chamæmorus)* in full flower were traversed, and in the neighbourbood of springs some otber alpines were found, sucb as *Epilobium alpinum*, *Caltha palustris* var. *minor*, *Thalictrum alpinum*, &c. On tbis part of tbe hill some rare insects were not uncommon, tbe best of them being *Scoparia alpina*, *Penthina staintoniana*, and *Sericoris irriguana*. At last tbe summit of tbe bill (3048 feet above sea-level) was gained, and the party assembled round tbe cairn, glad of a rest in the cooler mountain air after tbe great beat of the ascent. At the cairn a meeting of the Pertbshire Mountain Club was beld. Tbis Club, for wbicb only those members of the Society who bave ascended a Pertbshire mountain of at least 3000 feet altitude are eligible, was founded nine years ago, but since the deatb of Sir Thomas Moncreiffe, wbo was Cairnmaster or President, no meetings had been beld. On tbe motion of the Scribe and Annalist (Dr Buchanan White), Colonel Drummond Hay was unanimously elected Cairnmaster, and having taken his seat on the cairn, a number of new members were presented for initiation with the accustomed ceremonies. Tbereafter several vacancies in the list of office-bearers were filled up, Mr R. Brown, C.E., R.N., being appointed Geometer; and Mr Barclay, Quaighbearer. In the absence of the Bard (Mr John Young, C.E.), the following verses were read ón bebalf of tbe Deputy-Bard. It sbould be mentioned that the motto of tbe Club is "*Salix herbacea floreat*," *Salix herbacea* being tbe dwarf alpine willow, the smallest British shrub.

*SALIX HERBACEA FLOREAT!*

Once more at Flora's high behest
Our band has come from east and west,
To scale the mountain's rugged crest,
Salix herbacea floreat!

With rapture sparkles every eye:
The Ben towers upwards to the sky:
On yonder crags our pathways lie:
Salix herbacea floreat!

Dull are the blossoms here below,
Up there they shine with brighter glow,
Where blooms the Gentian of the snow,
Salix herbacea floreat!

The alpine Speedwell's glorious blue,
The Mossy Campion's rose-red hue,
Azalea, and Mountain Meadow-Rue,
Salix herbacea floreat!

Adown the dark cliff's mossy side
The sea-green Roseroot's scattered wide,
The Holly-ferns in crannies hide,
Salix herbacea floreat!

"Upon the mountain ledges green"
The Saxifrage's purple sheen
In many a splendid patch is seen!
Salix herbacea floreat!

And thou, blest Linne's own dear flower,
Dwelling now in some woodland bower,
Now where the alpine summits tower,
Salix herbacea floreat!

Up, brothers, up, scale ye the height!
He who ascends is in the right!
Below 'tis dark, above is light!
Salix herbacea floreat!

The Master issues his command,
"Leave far below the Lotos land!
"Around the Cairn take your stand!"
Salix herbacea floreat!

At last around the stones so gray
From whence the Master holds his sway,
The pilgrim band their footsteps stay,
Salix herbacea floreat!

"Fill up the Quaigh with mountain dew!
"Hand to each brother old and new
"And bid him say in accents true,
Salix herbacea floreat"

The Master calls upon his men
To fill the Quaigh up once again,
"To all friends round Lawers' mighty Ben
Salix herbacea floreat

"Fill, Quaighman, fill up as before!
"We drink to those who are no more,
"Who climbed the hills with us of yore!"
Salix herbacea floreat!

Having discussed the "finds" made on the ascent, the route of descent was arranged, and the meeting of the Club brought to an end. In descending the hill the party made a detour into Glen Turret to examine several lines of precipices which are a conspicuous feature of this side of the hill. After an interlude of snow-balling on a patch of snow that was crossed, the rocks were reached and explored. Many beautiful alpine plants were found in flower here. Amongst these were the green cushions studded with red flowers of the Mossy Campion *(Silene acaulis)*; the pendant dark green sprays of the Opposite-leaved Saxifrage *(Saxifraga oppositifolia)* being the large purple blossoms; the sea-green tufts, crowned with the yellow flowers of the Rose-root (*Sedum rhodiola*); the yellow *Potentilla maculata;* the brilliant blue of the Rock Speedwell (*Veronica saxatilis*), and many other gems. The rarest plants that came under observation were *Woodsia hyperborea*, of which two or three plants were seen; and *Linnœa borealis*, with its lovely sweet-scented rose-tinted blossoms. This locality for the *Linnœa*, which usually grows in fir-woods, was discovered by Mr Martin, of Aberuthven, some years ago. It occurs on the banks of a burn at an altitude of about 2000 feet above sea-level. Re-crossing the ridge, a descent was made upon Auchnafree, and, after an *al fresco* repast, a start was made for Perth, which was reached about midnight.

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JULY 26th.

6. *To Birnam.*

This excursion took place, but was omitted to be reported at the time.

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AUGUST 9th.

7, *To Banks of Tay, near Meikleour.*

This excursion was one of the most successful of the season, though the attendance of members might have been larger.

After meeting at Cargill Station, the party proceeded to examine the banks of the Isla between the Bridge and the Tay, finding a curious form of the rare *Carex aquatilis*, *Scirpus sylvaticus*, *Nasturtium palustre*, &c. At the Bridge some of the members went to see the celebrated beech hedge, said to be 90 feet high (60 feet of which is well clipped) and three-quarters of a mile long; while the rest of the party continued their investigation of the Isla down to its mouth. In the river they found the two species of British fresh-water sponges—*Spongilla fluviatillis* and *S. lacustris*. The former of these had not before been recorded as a native of Perthshire, though there was a suspicion that it occurs in the Tay at Barnhill. The colony of animals which composed this sponge form large masses of a yellowish green colonr, which encrust stones, and it is abundant in the Isla at this point. The other sponge usually occurs in lakes, and is of a much darker green than the other, in addition to which its shape is different, being like a small upright more or less branched twig. Moreover, it is usnally attached to dead wood, bnt sometimes to growing plants.

Near the mouth of the Isla a large bed of dockens *(Rumex)* afforded material for study. To the unbotanical eye one dock probably looks much like another, and all of them uninteresting; but the botanist finds in them mnch to study and admire. The parts in which the chief points of distinction are to be found are in the lower whorl of the envelopes of the fruit, which differ very mnch in shape in the various kinds, and are often of very elegant forms, besides being often brightly coloured, passing from varions shades of green to white, rosy, and bright red. Bnt the docks have an additional interest, in that they not unfrequently cross with each other, and produce new and puzzling forms. Amongst those at the month of the Isla were several which require to be stndied before names can be assigned to them. One seems to be the variety *trigranulatus* of *Rumex crispus*, a variety which has been recorded from very few places in Britain.

By the kindness of the Dowager Marchioness of Lansdowne, the party had leave to explore the beantifnl grounds of Meikleour. The route taken was along the bank of the Tay, which was found to be in several places very productive. In marshy places the gronnd was literally carpeted with the blue flowers of the true forget-me-not, mixed with the yellow cups of the money-wort *(Lysimachia nummularia)*. The latter plant is considered to be a doubtful native of Scotland, and is, at anyrate, not often to be found, except when it is an undoubted escape from cultivation. At Meikleour, however, and for several miles up the river, it grows in considerable abundance in marshy

places, and if not native, is at least thoroughly well-established. In a damp wood great masses of the broad-leaved bellflower (*Campanula latifolia*) were very conspicuous, the tall erect stems with their large blue or white bells being very handsome. The white-flowered form was nearly as abundant as the normal blue one. In a ditch a large bed of a plant that is very local in Perthshire—the bladder sedge (*Carex vesicaria*) was growing abundantly. A considerable quantity of this plant was seen in the course of the day, so that it is really more abundant in the county than was thought to be the case.

A marsh near Tayfarm produced a number of interesting things. The rarest of these is the great water-dock (*Rumex hydrolapathum*), a very handsome species 4 or 5 inches high. This species is confined to three or four localities in Perthshire. Along with it the Spear-wort (so-called from the state of the leaves), a kind of buttercup with large yellow flowers, grew in considerable masses; while the dark green leaves and chocolate brown heads of the mace-reed (*Typha latifolia*) filled the centre of the marsh, and formed an admirable background for the other plants.

A large shingly field, called the Inch, was next visited and was found to be equally productive, but of course of quite a different class of plants. The greater or less abundance of the sea campion (*Silene maritima*), sea thrift (*Armeria maritima*), and sea rib grass (*Plantago maritima*), gives these shingles the aspect of a sea-shore. Amongst them grew several local species, such as *Teesdalia nudicaulis*, which is very rare in Perthshire; *Sagina subulata*, and *S. nodosa*. In addition to these large patches of a stone crop, probably *Sedum rupestre*, grew abundantly amongst the stones. This plant is not admitted as a native of Scotland, and is most likely an accidental introduction in this place; but, wherever it has come from, it is now well established. Like the lupin (*Lupinus perennis*), which was seen in abundance, the stone crop in question has probably been brought down by the river from some garden.

The river bank was next explored and produced another rare Perthshire plant, *Astragalus glycyphyllus*, along with some others of less rarity, such as *Calamintha clinopodium*, *Origanum vulgare*, and *Malva moschata*. In a sandy field some perplexing forms of the creeping Tormentil were found. Possibly these may be *Potentilla mixta*.

In the old course of the river near Delvine several good things were discovered. The best of these was *Polygonum minus*, which here reaches its most northerly point (so far as is known) in Britain. The discovery of *Subularia aquatica* in one of the "backwaters" was a surprise. This little white-flowered water-plant is not uncommon in the Highland lochs, as well as in those near Dunkeld and Blairgowrie, these lochs being all either on the Silurian formation or on the Conglomerate, which lies close to it. The pool in which it was found at Delvine is on the Red Sandstone formation, and, so far as is known, is the only spot on that formation in Perthshire where it occurs. The other plants found here were *Peplis portula*, *Apium inundatum*, &c.

After this nothing very remarkable was found, and the party, proceeding to Caputh Ferry, crossed to Murthly Station and dispersed.

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SEPTEMBER 20th.

8. *Excursion to Longforgan and Invergowrie.*

This, the last excursion of the season, was fairly well attended. Starting from Longforgan Station, the party proceeded to examine the Huntly Burn or Pow in its lower course. A number of interesting forms of willows were observed here, some of them being kinds which had not been seen in other parts of the district. Where the burn joins the Tay various maritime plants began to make their appearance, such as *Scirpus maritimus*, *Aster trifolium*, &c. Also specimens of a sedge that is rare in Perthshire—*Carex vulpina*. Along the shores of the Tay various other maritime plants were noticed, but none of any particular rarity. The various quarries near Kingoodie were examined with interest and profit. Amongst the plants found here were *Ranunculus confusus*, *R. sceleratus*, *Malva sylvestris*, *Senecio viscosus*, *Sedum reflexum*, *Rumex crispus* var. *trigranulatus*, &c. Several mollusks were also obtained, including *Helix aspersa* (which is local and rare in Perthshire), *H. nemoralis* in several forms, *H. hispida*, and *Succinea sp.* Nearer Invergowrie Station some other local plants were seen, such as *Potentilla reptans*, *Fumaria densiflora*, and, as an "escape," *Linum usitatissimum*. After spending a short time in inspecting the ruins of Invergowrie Church the party returned to Perth.

# PROCEEDINGS

OF THE

# Perthshire Society of Natural Science.

VOLUME I. PART V.

1884–5.



PERTH:
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MDCCCLXXXV.

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# SESSION 1884-85.

NOVEMBER 13th, 1884.

Dr. F. BUCHANAN WHITE, F.L.S., President, in the Chair.

NEW MEMBERS.

The following were nominated :—Lord-Provost Martin ; Mr R. Kidson, Stirling ; Mr G. Barhour, Blairgowrie ; Mr Robt. Reid, Blairgowrie ; Mr Thos. Soutar, Commercial Bank, Perth ; and Mr David Cameron, Bridgend.

DONATIONS.

*I. To the Index Collection.*—Various snakes, &c.—from Mr R. Wilson, St John Street; "skeleton turnip"—from Mr H. Boyd, Bridgend; geological specimen—from Mr James Robertson, Fingask ; two chameleons—from Mr Montgomery, Caledonian Railway; snakes, &c.—from Messrs J. and H. Coates ; examples of tree-roots choking drain-tiles—from Mr Burns Macdonald ; fossil teeth of fish—from Mr F. Latham, Charleston ; human skull found below one of the arches of the Tay Bridge—from Mr J. C. Nicol, Perth Harhour ; specimens of flying-fish, &c.—from Mr Crichton, Balhousie Street ; very large "saw" of saw-fish, emeu eggs, and Australian stone implements—from Mr E. B. Cardell, Queensland, Australia ; and geological specimens—from Professor James Geikie, F.R.S.

*II. To the Perthshire Collection.*—Coot's and waterhen's nests and eggs—from Captain Smythe, yr. of Methven ; hooded crow, and eggs of curlew, red pole, and three species of gulls—from Mr M'Donald, Rannoch Lodge ; four geological specimens from the bed of the Tay at Tayport—from Mr J. Camphell, Edinburgh ; hooded crow—from Colonel Ogilvy of Rannagulzion ; nest and eggs of ring-ouzel—from Mr A. Stewart, Logiealmond ; nest of linnet—from Miss Juliet White, Annat Lodge; chaffinch—from Mr Kerr White, Annat Lodge; nest and eggs of Canadian goose—from Capt. Smythe, yr. of Methven; trout from Loch Laidon—from Colonel Drummond Hay ; nest and eggs of ring-ouzel, and egg of peregrine falcon—from Mr Laidlaw, Castle Menzies ; nests and eggs of water-ouzel, stone-chat, whin-chat, meadow-pipit, ring-ouzel, song-thrush, Ray's wagtail, greenfinch, bullfinch, golden-crested wren, willow-wren, common wren, house-sparrow, chaffinch and sedge-warbler, and eggs of jackdaw—from Mr G. Alexander, St Paul's Square ; adder — from Dr Buchanan White, F.L.S.; nest and eggs of wood-warbler —from Mr R. H. Meldrum, Cherryhank ; three trout—from Mr P. D. Malloch, High Street ; one trout—from Rev. J. M'Lean, Grandtully; nests and eggs of lesser red-pole, white-throat, and skylark—from Mr G. Alexander, St Paul's Square ; ice-marked houlder from the boulder-clay at Moneydie—from Rev. Dr Milroy ; nests and eggs of common wren, tree-creeper, and hlackcap—from Mr R. H. Meldrum, Cherrybank; geological specimens—from Mr W. Japp, Alyth ; golden eagle—from Sir R. Menzies, Bart.; garden-warbler, and nest and eggs of garden-warbler—from Mr P. D. Malloch, High Street ; two house mice—from Mr F. H. White, Annat Lodge ; grouse (a variety)—from Lord Stormont; trout (a variety) and corn-crake—from Mr G. Cameron, Aberfeldy; horse-shoe found 10 ft. below the surface on the banks of the Earn—from Mr T. Roy, Craigclowan ; linnet's nest and eggs—from Mr G. Alexander, St Paul's Square ; heetle, from Miss Robertson, Springbank ; common rat (curious variety, two specimens)—from Sir J. S. Richardson, Bart., Pitfour ; clay nodules—from Miss Jamieson, Barossa Place ; clay nodules—from Mr Carnachan, Wellshill Cemetery ; specimen of fungus *(Helvella crispa)*—from Mr Herd, Scooniehurn; specimens of fungus *(Polyporus squamosus)* —from Mr Nicol, Perth Harbour ; plants from Dunfallandy, Pitlochry—from Miss Rohertson, Springbank ; plants from Killin—from Mr D. M. Haggart, Killin ; a large collection of willows and roses—from Mr C. M'Intosh, Inver; several thousand specimens of various plants—from Dr Buchanan White, F.L.S. ; plants—from Mr James Coates, Mr A. Sturrock, and Mr W. Martin; large collection of plants from neighhourhood of Pitlochry—from Mr J. Brebner, Dundee ; large lahels for Perthshire trees—from Mr W. Ellison ; otter—from Sir R. D. Moncreiffe, Bart.; long-eared bat—from Mr C. L. Wood of Freeland ; stickle-back and sand-eel—from Mr John Stewart, Princes Street; two trout—from Mr A. Stewart, Moneydie; nests and eggs of jackdaw, sparrow-hawk, wood-pigeon, wild-duck, and carrion crow—from Colonel Drummond Hay; a series of nests and eggs, including redstart, tit-lark, starling, ring-ouzel, &c., &c. — from Mr M'Donald, Rannoch

Lodge; hedgehog—from Mr John Grant, Tullymet, Ballinluig; common buzzard—from Mr James Scott, Balchallan, Ballinluig; and six microscopic objects (various, mounted)—from Mr John Campbell, George Street.

*III. To the Library.*—10 volumes of publications of the Royal University of Norway—from the University; Larvæ of the British Lepidoptera—presented by James Grimmond, Esq., Oakbank, Blairgowrie; Report of Smithsonian Institution, 1882—from the Institution; and Report of U.S. Geological Survey, 1880-1—from the Department.

The following paper was read:—

"*Museum Notes.—I. Perthshire Mammalia.*" By Dr F. Buchanan White, F.L.S.

Under the title of "Museum Notes," the paper that I have the honour of laying before the Society to-night is the first of a series which has, I may say, been long contemplated by the managers of this Association. In forming a Museum the Society was, as you are aware, actuated by the belief that such might be made, not a mere collection of heterogeneous curiosities, but a powerful means of education. With this in view those who have planned and arranged the Museum have endeavoured to convey as much information as possible by the labels attached to each specimen or each group of specimens. But since the space allotted to such labels is necessarily restricted, it is desirable that they should be supplemented by a series of papers which may eventually form the groundwork for a handbook to the Museum. Each of these papers will be devoted to a group or part of a group belonging to one or other of the great kingdoms, and will demonstrate not only the principles on which the arrangement has been made, but will point out the deficiencies in the number of illustrative specimens, and hence, it is hoped, be of service by indicating what specimens are required.

The Mammals of Perthshire have been selected as the subject for the first paper, not only because they occupy the highest position in the classification, but because the collection is still very imperfect, and it is therefore desirable that attention should be called to the deficiencies in order that they may be filled up. Why there should be so many vacant places in the collection I know not, since many of the species are common enough and many promises of assistance have been made, though, I regret to say, not yet fulfilled. It is to be hoped, now that attention is called to the urgent need we have of specimens of many common animals, that our friends will endeavour to help us to get them. It is very probable that the reason why we have not got some of them is that they are supposed to be too common, and hence not worth sending in. This is, however, a mistaken idea, for not only do we require examples to illustrate the species, but to show the distribution throughout the county. That there is much need of information regarding the distribution I will endeavour to point out in the following notes.

The Mammals (or, as they are more commonly but less exactly termed, the quadrupeds) of Perthshire are about 33 or 34 in number. Of the 15 orders into which the class mammalia is divided 7 are represented in Perthshire. In the cases in which they are arranged in the Museum the chief points of distinction by which the orders are characterised are indicated on large labels placed before each order. Before each genus is a smaller label pointing out the characters of the genus and the number of species—British and Perthshire—contained in it; while before each species is another label giving information as to the habits, distribution, &c., of the species. Each species ought to be illustrated by a skull, as the dentition is of much importance in the classification; and by a number of specimens to show the distribution in the state and colour of the fur at different seasons of the year. To each specimen is attached a label showing the name, locality, and donor, and date when obtained.

The orders which are represented in Perthshire may be thus tabulated:—

Without hind legs, but with horizontal tail-fin,....Cetacea.
With hind legs;
Hind legs fin-like, ....................................Pinnipedia.
Hind legs not fin-like;
Feet with hoofs,......................................Ungulata.
Feet with claws;
Without canine teeth,..............................Rodentia.
With canine teeth;
Front legs formed for flying,.......................Cheiroptera.
Front legs not formed for flying;
Canine teeth small, ................................Insectivora.
Canine teeth large,..................................Carnivora.

*Order Carnivora.*

1. The Wild Cat (*Felis catus* L.). Of this we have no examples in the Museum, and it has now become so rare (if it is not altogether extinct) in Perthshire that there is not much hope of our obtaining a recently-killed specimen. A number of stuffed Perthshire specimens, however, are in existence, and we may hope that the possessor of one or other of them may some day be so generous as to present an example to the Museum, or, if unwilling to give it

altogether, at least to deposit it on loan. Information is very desirable as to when or where a wild cat was last killed or seen in Perthshire, and I should be glad if anyone who can give such information will communicate with me. Domestic cats which have run wild are sometimes mistaken for wild cats, but the two species are quite distinct. The latest occurrence (known to me) of the wild cat in Perthshire was in 1869, when one was killed at Finlarig by Mr Duncan Dewar.

2. The Fox (*Canis vulpes* L.) is still common enough throughout the country. We possess two specimens, one from the Highland hills, and one from the Sidlaws, but a few more—especially a good Lowland fox, and young cubs either Highland or Lowland—are desirable. We wish also a good skull.

3. The Yellow-breasted Marten or Marten Cat (*Martes sylvestris* Nils.) is not represented in the Museum, and is probably now very rare in Perthshire. Perhaps the possessor of a stuffed Perthshire specimen may be found generous enough to present or lend it to us. The latest instance of its occurrence (known to me) was at Finlarig in 1867.

4. The Weasel (*Mustela vulgaris* Erxl.) is common enough throughout the county. We have five specimens (including a curious mottled variety), but as they are all from Lowland localities, Highland examples are desirable. The latter may or may not show a difference in size or colour. This can only be seen when specimens are placed alongside each other. Lowland and Highland examples of some common animals show a marked difference. In connection with the weasel, it should be mentioned that some persons are of opinion that there are two species,—one much smaller than the other, and called the "Mouse Weasel." I believe that there is only one species, and that the supposed other species is founded only upon specimens of unusually small size. Still the matter is worth investigation.

5. The Stoat, or, as it is sometimes called, the Stoat Weasel (*M. erminea* L.) is also common enough in Perthshire, but we have only three representatives of it. As is well known, the stoat is subject to a change of the colour of its fur in winter. In cold countries this change always takes place, and specimens from more northern countries than ours have a high commercial value as "ermine." In more southern countries the change from the reddish fur to the white winter fur is not invariable. In Perthshire it is probable that the change is not invariable. A series of observations on this point would be very interesting. Amongst the points to be observed may be mentioned the following:—Do all the stoats in the locality where the observations are made change colour in winter? Is the change a complete one—*i.e.*, do they become completely white? Does the change take place every year, or is it dependent on the amount of cold? At what seasons do the changes from summer to winter fur, and from winter to summer fur, take place? For our collection we have need of specimens from both Highland and Lowland localities, and in various conditions of fur.

6. The Pole Cat (*M. putorius* L.). Rare in Perthshire, but occasionally seen both in the Highlands and Lowlands. We have no specimens.

7. The Badger (*Meles taxus* Schr.). Of this we have but a single specimen, and that not a typically-coloured one. The badger still inhabits several parts of Perthshire, but information as to its distribution is desirable. I know of only four or five places where it is said to be of regular occurrence, and should be glad to hear of others.

8. The Otter (*Lutra vulgaris* Erxl.) is, I believe, by no means uncommon throughout the county. We have three specimens, but would be glad of one or two more. The otter sometimes varies in colour, being occasionally spotted with white. It need scarcely be said that any such varieties would be very acceptable.

*Order Pinnipedia.*

9. The Common Seal (*Phoca vitulina* L.), of which we have yet no specimens. I suppose this is common in the lower part of the Tay, but it is not impossible that young individuals of the next species are mistaken for it. Seals occasionally come up the river as far as Perth—I have heard that they have been seen even as far up as Stormontfield,—but I am not aware that the species has been recognised.

10. The Gray Seal (*Halichœrus gryphus* F.). This is said to be a common species in the Tay, where it is called the "Black Seal." We have a young example of it.

11. The Hooded Seal (*Cystophora cristata* Erxl.). Very rare. It is included in our list only because a young individual was killed in St Andrews Bay (see *Scottish Naturalist* II., 1.) It is possible that the Greenland or Harp Seal (*Phoca grœlandica* F.) might be found as a straggler to the Tay if a lookout was kept for it.

*Order Cetacea.*

12. The Porpoise (*Phocœna communis* F. Cuv.) is the only species that is of regular occurrence. It has been seen as far up as Perth Bridge. We possess a small one from the lower Tay.

13. The Hump-backed Whale (*Megaptera longimana* Rud.). To this species belongs the well-known "Dundee Whale," whose occurrence allows us to include this amongst the mammals of the basin of the Tay.

Probably more than one other species should be included in this list, but information is needed as to what the species are. A small herd of Bottle-nose Whales visited the Old Harbour at Perth many years ago, but as the name "Bottle-nose" is given to several species it is now impossible to say what this particular one was.

*Order Ungulata.*

14. The Red Deer (*Cervus elaphus* L.). Still common in several parts of the Highlands of Perthshire. We possess two very fine specimens, thanks to the kind generosity of Lady Willoughby d'Eresby. Though now confined to deer-forests and their neighbourhood, this species once occurred all over the country. We have a proof of this in a head which we possess from the "buried forest" bed of the Carse of Gowrie.

15. The Roe-Deer (*Capreolus capræa* Gray) is common throughout Perthshire, but as yet we have only one small specimen without antlers. It is unnecessary to add that other specimens will be very acceptable. The Fallow Deer (*Cervus dama* L.) occurs in several parts of Perthshire but it is not an indigenous species.

*Order Insectivora.*

16. The Hedgehog (*Erinaceus europœus* L.). Very common, at least in the Lowlands. Information is desirable as to its distribution in the Highland part of the county. We possess only three examples, and Highland ones are desirable. This is one of the fifteen or sixteen species that have occurred within the municipal boundaries of Perth.

17. The Mole (*Talpa europœa* L.) Too common to require mention beyond the fact that we have no specimens except one (a fawn coloured variety), and that therefore specimens are needed, both Lowland and Highland. Several colour-varieties occur, and should be secured. This is one of the animals which should be skinned as soon as killed, as otherwise the fur on the sides of the abdomen is apt to come off.

18. The Common Shrew (*Sorex tetragonurus* Herm.).

19. The Lesser Shrew (*S. minutus* L.).

20. The Water Shrew (*Crossopus fodiens* Pall.).

These are all probably more or less common, but we possess examples of only one of them—the water-shrew. These animals may be thus distinguished from each other —the water-shrew has the upper edge of the lower incisor (front) teeth nearly entire, aud the tail and feet have a fringe of stiff hairs. The other two have these teeth formed like a saw at the edge, and their tails and feet have not the fringe of stiff hairs. The common shrew is reddish mouse-colour above, paler below, and the tail is rather shorter than the body; the lesser shrew is a smaller animal (less than two inches without the tail), and is brown above and white beneath, and the tail is usnally longer than the rest of the body; the water-shrew is nearly black above and white beneath, but is snbject to much variation in its colour, the tail is two-thirds the length of the body. There are other points of distinction between the three species, but these will serve to identify them. Specimens of all of them from varions localities, are very desirable, as reliable information about their distribution in the county is much needed, as well as specimens for the collection.

*Order Cheiroptera.*

21. The Common Bat (*Vesperugo pipistrellus* Schreb.). Common enough, but (I suppose consequently) we have only a single example. I suspect, but I may be wrong, that since the severe winters we had a few years ago, bats have been less common here than they were before. Information is desirable as to the distribution of the common bat in the Highland districts, and as to the altitude it ascends on the hills.

22. The Long-eared Bat (*Plecotus auritus* L.). Probably not rare, at least in the Lowlands, but I know nothing about its distribution, and hence information would be acceptable. We have only two specimens.

It is probable that one or more other species of bats may occur with us, as, for example, Daubenton's Bat (*Vesperugo Daubentoni* Leisl.), but this can be ascertained only by procuring specimens. One of the horse-shoe bats (so called because of the membranous appendage upon the nose) is suspected (on good grounds) to have occurred near Loch Tay, but as it is not otherwise known as a native of Scotland, and as no specimen has been preserved, we cannot admit it into this list at present.

*Order Rodentia.*

23. The Squirrel (*Sciurus vulgaris* L.). Now common in all the wooded districts, though at one time it had become rare, if not extinct, in many places, owing to the destruction of the woods. We have only two specimens, and hence require more to illustrate the distribution. The fur is subject to some variation in colour, being different in summer, autumn, and winter. Our specimens show the summer fur, so that we require specimeus procured at other seasons. The autumnal specimens have paler (cream-coloured) tails.

24. The Black Rat (*Mus rattus* L.). This is sometimes confounded with the black variety of the water-vole—a very different animal. We have no evidence that the black rat was ever a Perthshire animal, but as at one time it was the common rat of the country, there is little donbt that it was. It seems to have been introduced into Bri-

tain about the middle of the sixteenth century, and to have been abundant enough till exterminated in most places by the stronger brown rat, which arrived in the eighteenth century. The black rat still survives in some seaports, and it is possible that we may be able yet to obtain specimens from the basin of the Tay.

25. The Brown or Common Rat (*Mus decumanus* Pall.). Far too common, though it is not much more than one hundred years ago that it first invaded Scotland. We have only one specimen of the common form, but two of a beautiful chesnut-coloured variety, recently obtained by Sir J. S. Richardson at Pitfour.

26. The House Mouse (*Mus musculus* L.). Also much too common, though we have only two examples. Several varieties occur in a wild state, and we should be glad of examples of these. Those which inhabit ricks and barns are larger and darker than those living in houses. Of these, specimens would be acceptable.

27. The Long-tailed Field Mouse (*Mus sylvaticus* L.). A common species, but we have only two individuals. The Harvest Mouse (*Mus minutus* Pall.) is very probably a Perthshire animal, but I have not seen nor heard of any specimens, and, therefore, cannot yet include it in our list. Beside being much smaller than the long-tailed field mouse (about half the size), the ears are only one-third instead of more than one-half the length of the head, and it is more distinctly and more sharply marked with white on the underside of the body.

28. The Short-tailed Field Mouse, or Field Vole (*Arvicola agrestis* De Selys.). The voles may be readily distinguished from the rats and mice proper by their tails, which, besides being shorter, are hairy instead of nearly naked and scaly. The field vole is common in Perthshire (though we have only one specimen), but it is desirable that its distribution should be recorded.

29. The Red Field-Vole, or Bank-Vole (*Arvicola glareolus* Sch.). We have no specimens of this. It is a little smaller than the previous species, is reddish-chesnut-coloured above and white below (instead of greyish-brown above and pale grey below), and the tail is one-half the length of the body instead of only one-third. It seems to be more local in its distribution. In Perthshire it has been recorded from the Loch Tay district only, but probably occurs elsewhere.

30. The Water-Vole, or Water-Rat (*Arvicola amphibius* L.). A common species in the Lowlands, but information as to its Highland distribution is desirable. Two forms occur, differing in colour. The common form is greyish brown, paler beneath ; the more local one is deep black all over. The three specimens we have seem to belong to the latter form. Specimens of both forms will be acceptable.

31. The Common Hare (*Lepus timidus* L.). Still common enough, though apparently less abundant than it was a few years ago. In our collection this species is represented only by a curious grey-coloured variety. Information as to its distribution in the Highland districts is desirable.

32. The Mountain Hare (*Lepus variabilis* Pall.). Common on the mountains. We have four specimens showing different states of the fur, but one or two in the summer fur are required.

33. The Rabbit (*Lepus cuniculus* L.). Though not an indigenous species, the rabbit is now very abundant. Highland specimens seem to differ from Lowland ones in size and colour, and there are besides other colour-varieties amongst wild rabbits. Any of these will be acceptable, as will examples of the common Lowland form, those we possess being Highland.

In concluding this paper, I wish again to solicit assistance from all who desire to help us in our efforts to make the Museum as perfect as possible. Considering that it is only about two years since we began to make the collections, some of the departments are, I think, very creditable, but this credit cannot be claimed for the collection of mammals. There are (as will have been seen from my remarks) many common species that are inadequately represented by specimens. It is very probable that it is because these species are common that no one thinks it worth while sending in examples. But now that the need of them has been pointed out, I trust that the kind friends who have assisted us in getting specimens in the other departments will help us,—and that without delay,—in this also. Any specimens addressed to me (Dr Buchanan White, Annat Lodge, Perth) will be thankfully received, and placed in the Museum.

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## December 4th, 1884.

F. Buchanan White, M.D., F.L.S., President, in the Chair.

### NEW MEMBERS.

The following were elected :—Lord-Provost Martin; Mr T. Soutar, Commercial Bank; Mr Geo. Cunningham Roy,

Perth Savings Bank; Mr R. Kidston, Stirling; Mr J. Barbour, Blairgowrie; Mr R. Reid, Blairgowrie; Mr D. Cameron, Bridgend; and Mr W. Farquharson.

The following were nominated for election at next meeting:—Major Dudgeon, Depute-Governor of the General Prison, and Mr W. Anderson, Balhousie School.

### DONATIONS.

The following were intimated:—

I. *Perthshire Collection.*—Specimens of lead ore from Glen Lyon—from Mr J. Robertson, Meggernie; teal duck—from Mr Stewart, Kinfauns Station; specimens of marine Crustacea from Firth of Tay—from Mr Frank Henderson, Barrack Street, Dundee; thrush's nest and eggs, and hedge-sparrow's nest and eggs—from Mr W. Duncan, Almondbank; owl—from Mr R. M'Intosh, Grandtully. The following specimens of the Mammals of Perthshire had been received in response to the appeal made at last meeting:—Two albino specimens of the common or brown hare, shot at Lynedoch — from Lord Stormont [specimens with white spots had been seen there before, but none altogether white, these being very rare]; wild cat, shot on Craig Vinean about 30 years ago—from Mr W. Pitcaithly, Inver, Dunkeld; two rabbits — from Captain D. M. Smythe, yr. of Methven; two stoats, one common shrew, and three long-tailed field mice—from Mr D. Dewar, Remony, Kenmore; weasel—from Mr R. M'Intosh, Grandtully; otter—from Mr J. S. Cruickshank, St John Street.

II. *Index Collection.*—Mineralogical specimen—from Mr W. Barclay, Perth.

### NOTE ON THE OCCURRENCE OF THE PARROT CROSSBILL IN PERTHSHIRE, AND PROBABLE NESTING.

Dr Buchanan White said that he had received the following note from Mr J. G. Millais regarding the parrot crossbills and other rare birds which were reported in the newspapers to have been recently obtained by that gentleman in Perthshire:—"With reference to the parrot crossbills, I was lucky enough to obtain five of them—two old birds, and three young. They had evidently bred somewhere in the fir-woods of Murthly, as the old hen had all the feathers worn off her breast, showing that she had undoubtedly been sitting on eggs quite lately. The young themselves, although I do not think they had been out of the nest more than a month, had beaks larger than the largest specimen of the common crossbill. There was a flock of about 20 of them." Mr Millais added that he would present to the Museum a specimen of the parrot crossbill, and also the reeve recently shot by him at Murthly. He mentioned that among other rare birds that he had obtained in the basin of the Tay were the following:—Roseate tern, green sand-piper, ivory gull, Iceland gull, Buffon's skua, purple gallinale (shot at Errol), &c. Dr White mentioned that, though it was stated in the newspaper paragraph referred to that the parrot crosshill had not been noticed in Scotland before, this was not the case, as it had occurred in at least four places. It had not before, however, been proved to breed in Britain.

### REPORT OF THE DELEGATES (DR BUCHANAN WHITE, F.L.S., AND MR ROBERT PULLAR, F.R.S.E.) TO THE MEETING OF THE EAST OF SCOTLAND UNION OF NATURALISTS' SOCIETIES AT DUNDEE.

REPORTED BY DR BUCHANAN WHITE.

As was duly intimated to each member of the Society, the first annual meeting of the Union was appointed to be held in Dundee on the 6th and 7th of June last. The local arrangements were left in the hands of the Dundee Naturalists' Society, by whom they were admirably carried out. The proceedings began with a meeting of Council, at which it was agreed that each Society in the Union should be assessed at the rate of sixpence for every paying member in it, for the first year. The hope was expressed that a smaller assessment would be sufficient for future years, but in view of the important works on the Natural History of its district that the Union hoped to publish, it it was believed that none of the Societies would grudge this assessment even if it were necessary to impose it again. It was also decided that the "Preliminary Reports" on the natural history of the district embraced by the Union, which were to be read at the general meeting, should be published.

The general meeting was well attended by members of the various Societies in the Union. After an inaugural address by the President, the reports above referred to were received, and as much of each as time permitted was read. It is gratifying to notice that members of our Society had a prominent position in this first meeting of the Union, as out of 19 reports 8 were furnished by them. The President of the Union also was a member of our Society. In the evening a very successful Conversazione was given to the members of the Union by the Dundee Naturalists' Society. The second day of the meeting was devoted to excursions, one by land and one by sea, which were well attended and very successful. The proceedings were brought to a termination by a final meeting,

at which brief reports of the results of the excursions were given in, and a well-deserved vote of thanks accorded to the local Society for the successful manner in which it had carried out all the arrangements for the annual meeting.

No definite arrangement has yet been made for next year's annual meeting. Though your delegates are fully sensible of the claims of Perth as the locality in which an early meeting should be held, they are of opinion that, as the foundation meeting of the Union was held in Perth, and the first annual meeting in a locality so near at hand, it would not be desirable for the sake of the Union to have next year's meeting here, but rather in some more distant part of the district. They did not therefore think it advisable to bring forward the claims of Perth on this occasion. At the same time they consider it desirable that our Society should invite the Union to fix Perth as the place of the annual meeting at no very distant date, and solicit instructions on this point.

### REPORT OF THE DELEGATES (MR ROBERT PULLAR, F.R.S.E., AND MR RUFUS D. PULLAR, F.C.S.) TO THE MEETING OF THE BRITISH ASSOCIATION AT MONTREAL.

REPORTED BY MR ROBERT PULLAR.

I had the honour of being nominated as delegate from the Perthshire Society of Natural Science to the great meeting of the British Association for the Advancement of Science, which held its annual meeting this year at Montreal from August 27 to September 3. I feel a difficulty in knowing how to give an account of my stewardship, so many and varied were the experiences of that memorable occasion. I saw so many scientific men, British, Foreign, and Colonial, and heard so much about their various researches, that a feeling akin to despair was engendered as I realised how little I comprehended of the vast stores of learning poured forth in the various sections during so many days in the beautiful and commodious rooms of the Macgill University and adjacent buildings. The meetings of the British Association are at all times interesting and improving,—no better holiday can be spent, no pleasanter recreation can be obtained, than to go to the autumnal Association meetings wherever they are held,—but this occasion was one of peculiar interest, seeing it was the first on which the Association had held meetings beyond the bounds of our own country. Grave doubts were at first expressed as to the wisdom or policy of this movement, but the experiment has proved an entire success, and doubtless ere many years elapse some of our other colonies will be visited. In proof of the desire for this, an application was considered at the meeting of the British Association Committee in London on 11th November, in which the city of Melbourne cordially invited the Association to pay a visit at some early period to that great Australian city.

I shall not detain you by attempting any description of the voyage across the great Atlantic. It had its ups and downs like all other paths through life, and science has not yet sufficiently advanced to provide a remedy for those cruel rollings and tossings which agree so badly with many constitutions, but which once over are soon forgotten. In one respect we did profit greatly by the advancement of science, as our good ship *Germanic* was lighted throughout with the incandescent Swan lamps, and a very great improvement they were over the evil-smelling and dismal oil lamps of former days, besides greatly diminishing the risk of fire. The excellence of the arrangements made by the Montreal Committee was worthy of all praise, and added much to the comfort and pleasure of visitors. The Dominion Government and the local authorities, the railway and steamer companies, the cable and telegraph companies, the authorities of Macgill University and other public institutions, as well as private individuals, vied with each other in their kind consideration for the comfort of visitors; and, favoured as we were with bright and pleasant weather, we were able to appreciate and enjoy the afternoon garden parties and excursions, as well as the morning meetings of the Sections, where so many valuable papers were read and scientific discussions took place. At least 800 members attended from Great Britain, and as many more from various parts of Canada and the United States became associates for the Montreal meeting.

It was gratifying to find so many delegates from local societies like our own. At least 50 were so represented, and an important meeting of the delegates was held, at which I was present, when the following rules were submitted as those under which local scientific Societies may be connected with the British Association:—

*Corresponding Societies.*

(1) Any Society is eligible to be placed on the List of Corresponding Societies of the Association which undertakes local scientific investigations, and publishes notices of the results.

(2) Applications may be made by any Society to be placed on the List of Corresponding Societies. Application must be addressed to the Secretary on or before the first of June preceding the annual meeting at which it is intended they should be considered, and must be accompanied by specimens of the publications of the results of the local scientific investigations recently undertaken by the Society.

(3) A Corresponding Societies Committee shall be annually

nominated by the Council and appointed by the General Committee of the British Association, for the purpose of considering these applications, as well as for that of keeping themselves generally informed of the annual work of the Corresponding Societies, and of superintending the preparation of a list of the papers published by them. This Committee shall make an annual report to the General Committee, and shall suggest such additions or changes in the List of Corresponding Societies as they may think desirable.

(4) Every Corresponding Society shall return each year, on or before the first of June, to the Secretary of the Association, a schedule, properly filled up, which will be issued by the Secretary of the Association, and which will contain a request for such particulars with regard to the Society as may be required for the information of the Corresponding Societies Committee.

(5) There shall be inserted in the Annual Report of the British Association a list, in an abbrevated form, of the papers published by the Corresponding Societies during the past twelve months which contain the results of the local scientific work conducted by them; those papers only being included which refer to subjects coming under the cognizance of one or other of the various Sections of the Association.

(6) A Corresponding Society shall have the right to nominate any one of its members, who is also a member of the Association, as its delegate to the annual meeting of the Association, who shall be for the time a member of the General Committee.

*Conference of Delegates of Corresponding Societies.*

(7) The Delegates of the various Corresponding Societies shall constitute a Conference, of which the Chairman, Vice-Chairmen, and Secretaries shall be annually nominated by the Council, and appointed by the General Committee, and of which the members of the Corresponding Societies Committee shall be *ex officio* members.

The Conference of Delegates shall be summoned by the Secretaries to hold one or more meetings during each annual meeting of the Association, and shall be empowered to invite any member or associate to take part in the meetings.

The Secretaries of each Section shall be instructed to transmit to the Secretaries of the Conference of Delegates copies of any recommendations forwarded by the Presidents of Sections to the Committee of Recommendations bearing upon matters in which the co-operation of Corresponding Societies is desired; and the Secretaries of the Conference of Delegates shall invite the authors of these recommendations to attend the meetings of the Conference and give verbal explanations of their objects and of the precise way in which they would desire to have them carried into effect.

It will be the duty of the Delegates to make themselves familiar with the purport of the several recommendations brought before the Conference, in order that they and others who take part in the meetings may be able to bring those recommendations clearly and favourably before their respective Societies. The Conference may also discuss propositions bearing on the promotion of more systematic observation and plans of operation, and of greater uniformity in the mode of publishing results.

From these rules it will be seen that our Society will have the honour and benefit of being connected with the great central Association so long as we undertake local scientific investigations and publish notices of the results. I hope this may prove an additional stimulus to our members to pursue scientific work, so that our Society may not be behind others in either quantity or quality of work from year to year.

I shall not attempt to give even a *resumé* of the papers read at the sectional meetings. The chief ones have been reported with remarkable promptitude in the *Times*, *Scotsman*, *Nature*, and other papers and journals. The proceedings were fittingly commenced by admirable addresses from His Excellency the Governor-General and the President, Lord Rayleigh, who gave a very interesting review of recent progress in science, especially Physics. I shall only quote the closing words of his Lordship's address, with the recommendation that if you have not read the whole you ought now to do so. His Lordship concludes as follows :—

Without encroaching upon grounds appertaining to the theologian and the philosopher, the domain of natural science is surely broad enough to satisfy the wildest ambition of its devotees. In other departments of human life and interest, true progress is rather an article of faith than a rational belief; but in science a retrograde movement is, from the nature of the case, almost impossible. Increasing knowledge brings with it increasing power, and great as are the triumphs of the present century, we may well believe that they are but a foretaste of what discovery and invention have yet in store for mankind. Encouraged by the thought that our labours cannot be thrown away, let us redouble our efforts in the noble struggle. In the Old World and in the New, recruits must be enlisted to fill the place of those whose work is done. Happy should I be if, through this visit of the Association, or by any words of mine, a larger measure of the youthful activity of the West could be drawn into this service. The work may be hard, and the discipline severe; but the interest never fails, and great is the privilege of achievement.

The addresses of the various Presidents of Sections were also valuable and instructive, and I listened with special interest to the address of Sir H. Roscoe, President of the Chemical Section, who reviewed the history of chemical science during the last 40 years. Had time permitted, I would have liked to give a few quotations, but I forbear.

I shall only refer very shortly to some of the excursions provided for the members of the British Association. The great one in every sense was that to the Rocky Mountains, *via* the new Canadian Pacific Railway, which stretches 2500 miles westward from Montreal. Return tickets were

provided free of charge to all members who chose to apply for them, and about 200 availed themselves of this privilege; while others, like my own party, were satisfied with much shorter journeys. We visited among other places Toronto, Ottowa, and Quebec. At Quebec we joined a party of 200 British Association members who were conveyed by special steamer 180 miles down the beautiful St Lawrence River. We were received on arrival by the Mayor and Corporation of Quebec; were conducted by them to all points of interest in and around that quaint and beautiful city, and afterwards entertained at a splendid banquet in the St Louis Hotel, where suitable speeches were made and hearty votes of thanks proposed to our hospitable entertainers. Later in the day the Lieutenant-Governor of the Province of Quebec held a reception at his beautiful residence, Spence's Wood, on the River St Lawrence, two miles from Quebec; and in the evening the Governor-General and Lady Lansdowne gave a splendid fête at the Citadel in honour of the British Association. It was intended to conclude this entertainment by a display of fireworks from the esplanade of the Citadel overlooking the St Lawrence River, but instead thereof Nature supplied her own fireworks in shape of a terrific thunderstorm with lightning of a brilliance and rain of a denseness which we seldom see in our country. It was a grand sight, and I need scarcely say that the ordinary rockets and other pyrotechnics prepared for our delectation were utterly extinguished. This visit to Quebec came as a pleasant rest in the middle of the Montreal meetings, and we returned refreshed and strengthened for further work in the Sections.

We were much pleased also with our visits to the beautifully-situated cities of Ottowa and Toronto. We found at both of these places, as well as at Quebec, large and well-organised schools and colleges. The Canadians seem fully alive to the importance of educating their rising generation, and spare neither expense nor trouble to have this attended to in the very best manner. The whole educational system of the country is under the superintendence and control of a Minister of Education, who seems to have ample work on his hands, as in every village an efficient school is to be found.

It was a happy thought of some members of the British Association to commemorate their visit to Canada by founding a gold medal for the Faculty of Applied Science in the Macgill University. About £500 was subscribed for this object.

Of the results of the Montreal meeting it is impossible to speak particularly as yet. The general impression is that a greater interest in scientific inquiry will be aroused among all classes, and the visit must also prove very useful by the attention of so many intelligent scientific men being directed to the vast extent and resources of the Dominion of Canada—a country as large as Europe, and with room for any number of active and enterprising people, who will there find ample reward for their labour if they are willing to work. There are times of difficulty and dulness of trade there as here, but they are generally of short duration, and will probably become less frequent as sounder views of political economy become prevalent among the Canadian people and their rulers.

The concluding meeting of the Association was as interesting as any that preceded it, and on that occasion many of our most distinguished *savans* received the diploma of LL.D. from the Senatus of Macgill University. A special train was organized for the following day to convey members of the British Association who wished to attend the meetings of the "American Society for the Advancement of Science" at Philadelphia, a distance of 400 miles. About 250 members availed themselves of this arrangement, and reached Philadelphia rather tired and worn out by their long journey.

Of our reception and meetings at Philadelphia I leave others to speak.

## REPORT OF THE DELEGATES (MR RUFUS D. PULLAR, F.C.S., AND MR ROBERT PULLAR, F.R.S.E.,) TO THE MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, AT PHILADELPHIA.

REPORTED BY MR RUFUS D. PULLAR.

It was my good fortune this autumn to be able to attend not only the meetings of the British Association for the Advancement of Science held at Montreal, of which you have just had some account given you, but also those of the American Association for the Advancement of Science. This "Convention of Scientists," as our cousins across the Atlantic term it, was held this year at Philadelphia. The city has many institutions of general and scientific interest, and as most of them opened their doors to the scientists, I shall endeavour to introduce you to them as well as words and time will permit. I should do the Philadelphians wrong were I not at the outset to express my sense of their kindness and hospitality to strangers. They receive visitors from the "old country" most cordially at all times, and spare no trouble to give them pleasure or information, but I am sure it is the unanimous opinion of members of the British Association that this year they have excelled themselves. The British Association invited members of the American

Association to take part in our Montreal meeting as honorary members, and we were invited to the American Association meetings on the same footing. The citizens of Philadelphia, however, came forward and joined the scientific association in giving us a most cordial welcome. At least a dozen different Committees must have been busy for weeks making arrangements; so that at Montreal those who had intimated their wish to go to Philadelphia found gentlemen ready to give every information, and the details of such an attractive programme as that drawn up for the week must have induced many others to re-arrange their plans and accept the invitation to go to Philadelphia. In all about 300 members of the British Association did so, and fully 150 of us availed ourselves of a special train which was run through from Montreal. We had the exceptional privilege accorded us of passing from Canada into the States without undergoing a Custom's examination. Of the long hot day's journey in an American railway car which followed, the less said the better, but the cool of the evening found us running along the bank of the Hudson (the American Rhine), and enjoying the charming continually-changing picture which the river by moonlight presents. In due or rather undue time we passed through Jersey City (the mainland portion of New York), and here a deputation from Philadelphia joined the train, and occupied the time *en route* in arranging as to the excursions we wished to take part in on the Saturday.

The American Association is constituted very much on the same lines as our British Association, and conducts its meetings in much the same way. We were requested as early as possible to register our names and addresses at the reception-room, and on showing our British Association member's ticket to one of the staff of lady-clerks in attendance, we received a badge stamped with our number on the register. The badges bore symbols appropriate to each section, as follows:—A. Mathematics and Astronomy—a telescope; B. Physics—a telephone; C. Chemistry—a combustion furnace and Liebig's bulbs; D. Mechanical Science—a fly-wheel; E. Geology and Geography—a globe; F. Biology—a heart; G. Histology and Microscopy—a microscope; H. Anthropology—a skull; I. Economic Science and Statistics—some books. These badges had to be worn, as they formed the passport to all the meetings and entertainments offered to the Association. The meetings were opened on the forenoon of Thursday, 4th September, by the retiring President, Professor Young of Princeton, formally resigning the chair to Professor J. P. Lesley of Philadelphia, who expressed his confidence that the Convention would prove alike pleasant and profitable. His grounds for this confidence were that, in addition to the unusually numerous American associates who would be in attendance, there was an unexpectedly large number of distinguished friends and allies from abroad, and there was the coincident occurrence of the Electric Exhibition, held under the auspices of an Institute named after the great demonstrator of lightning. The Governor of Pennsylvania then welcomed the Association on behalf of the State, and the Mayor on behalf of the city, remarking that in their opinion no better place could have been selected for the Convention meeting than the birthplace of Robert Fulton and the dwelling-place of Benjamin Franklin.

It appears that the first meeting of the American Association was held in Philadelphia in 1848, and since then it has held its yearly sessions in the principal cities of the Union, and this year returned to Philadelphia for the first time. The list of foreign Societies (among them our own) represented by delegates was then read, and a fraternal cablegram was sent to the French Association for the Advancement of Science, at the same time in session. After this the various Sections met in their respective halls, and heard and discussed papers, none of which call for special note. In the evening, Professor J. S. Newberry, of Columbia College, New York, gave an illustrated lecture on "The Geological Evolution of the North American Continent." For a report of this I must refer those interested to the forthcoming official report of the American Association for the Advancement of Science, or I daresay the lecture has been published in some of the recent geological journals. At the close, Professor C. S. Minot, of Boston, read the following petition, signed by many leading scientists:—

The undersigned respectfully request the British Association and the American Association to consider the advisability of forming an International Scientific Congress to meet at intervals in the different countries, and if it should be found desirable, to take measures to initiate the undertaking.

He said that this movement was of a purely spontaneous character, and had been favourably received by the British Association at Montreal, and referred to an influential Committee. It was also very favourably received by the American Association, and a Committee consisting of leading men in various branches of science was appointed to consider and report on the subject, which appears now to be taking definite shape.

During the next day all the sections were fully occupied with their special work, and in the evening, according to the custom of the American Association, the retiring President, instead of the new President as with us, delivered an address. Professor Young

took as his subject "Pending Problems in Astronomy," for a report of which I must refer you to *Nature* for September 18th, vol. 30, p. 501. Dr Ball, whom we all know, proposed a vote of thanks in a characteristic speech, and after this the meeting resolved itself into a conversazione, and there was much promenading, introducing, hand-shaking, and general good fellowship. The next day being Saturday was devoted to excursions, the most important being to the wonderful anthracite coal-fields of Pennsylvania, but your representatives were so overcome by the excessively hot weather that they were glad to leave the pursuit of science for a day, and joined one of the minor excursions to the sea-shore. Sunday was of course a *dies non* with the scientists. On Monday, at the usual general meeting, which I ought to explain it is the custom of the American Association to hold every morning in order to consider matters of general interest before the sections meet, Professor Young stated that he had no formal report to make from the Committee on Interchange of Courtesies between the American and British Associations for the Advancement of Science. The result of the Committee's work was to be seen in the presence of the British Association at the Convention. He therefore moved that the Committee be discharged. Professor Lewis suggested that the Committee be continued, and make some arrangement by which the Associations could be more closely united, and the present pleasant relations between them be sustained. It was then agreed for the Committee to continue its work. This subject was again brought up at the concluding meeting of the Convention, when Captain Bedford Pym, in offering a resolution expressing the thanks of the British Association to the citizens of Philadelphia, stated he had set his heart on the American Association meeting in London, and promised we would give them a reception second only to the one they had given us.

Later in the day, the directors of the Zoological Gardens invited members to witness some experiments by Mr Muybridge in photographing animals in motion, which he is carrying on in their garden for the University of Pennsylvania. These experiments have already been noticed in our newspapers and photographic journals. The Zoological Society buildings and grounds are probably unexcelled for comfort and convenience. Great care is taken of the animals, the collection of which is large, and comprises many rare and valuable specimens. The garden forms part of the famous Fairmount Park. This is probably the largest improved public pleasure-ground in the world, extending as it does to close upon 3000 acres. For miles on both sides of the winding Schuylkill River, stretching far back into the country, are hill, forest, and dale, forming a park free to all, and unrivalled for natural scenery by any in the world. The authorities of Pennsylvania University received members in their hall, and the professors and graduates acted as guides in showing us over the buildings. The College is divided into departments of Arts (including philosophy, music, finance and economy), Medicine (including dentistry and veterinary surgery), Science, and Law. The College buildings are among the largest of the kind in America. Externally they present an attractive appearance, and the laboratories and lecture-rooms devoted to scientific subjects, of which I took more special cognisance, are well fitted up, and contain a good collection of scientific apparatus.

A reception was also given to members by the authorities of the Women's Medical College. This was originally formed in 1849, and was the first distinctive medical school for women in the world. The present building contains ample laboratories and lecture-rooms. The majority of the professors are women, and many of the graduates are now in successful practice. On Tuesday, 9th Sept., there was a discussion in the Chemical Section on "Educational Methods in Laboratory Practice, and in the Illustration of Chemical Lectures." The speakers generally advocated the early introduction of quantitative experiments capable of yielding approximately accurate results, in place of the usual qualitative work, which induces careless methods of working, and methods which have to be unlearnt when higher work comes to be undertaken. This is a subject well worthy the attention of teachers of chemistry and examining boards. There have been some letters on the subject in *Nature* lately, to which I would refer those interested. (Nov. 6, 13, and 20. Vol. 31, pages 19, 28, and 52.) In the evening Dr Ball lectured to a large audience on "The Distance of the Stars;" after which there were receptions given in the Academy of Fine Arts and in the Academy of Natural Sciences. The Academy of Fine Arts is a splendid building devoted entirely to the cultivation of artistic talent. Entrance to the school is only obtainable by applicants who can show drawings indicating sufficient capacity. The primary object of the Academy of Natural Sciences is the promotion of original investigation by means of the varied facilities offered within its walls, but it has also four professorships giving regular instruction in archæology, ethnology, zeology, paleontology, mineralogy, and geology. The library contains 30,000 scientific books. The collections are extensive. The birds number some 35,000 specimens, and reptiles and fishes are abundantly repre-

sented, but the most complete department is that of Conchology.

On Wednesday, 10th, after the usual sectional work, the Ladies' Reception Committee invited members to a garden party in the grounds of Haverford College. The managers of the Electric Exhibition had also specially invited members for this day, and we devoted ourselves to an examination of their exhibits. The exhibition was held under the auspices of the Franklin Institute, and being the first American exhibition devoted exclusively to the illustration of the progress of electric science, it naturally attracted much attention in the States. There was certainly a very good and interesting display, but nothing very novel, and I do not suppose that it was in any way superior to the Electric Exhibitions which have been held in this country and on the Continent. The Franklin Institute was founded in 1824 for the promotion of the mechanical arts, and now possesses valuable collections of models and instruments. It does much good work in the way of providing lectures, and by the publication of its journal, which gives authentic information concerning all advances in the mechanical arts. Thursday, 11th Sept., saw the close of the Convention. Many of the sections had finished their business on the previous day, and did not meet. In the evening a concluding meeting, to which I have already referred, was held in the Academy of Music, and two hours were spent in the exchange of civilities,—votes of thanks being given to each and all of the various bodies who had combined to give the Association such a hearty welcome. Altogether it was considered that this 1884 Convention was the most successful in the annals of the American Association for the Advancement of Science.

And now, does some one ask, what practical good results from meetings such as those we have endeavoured to describe to you? Are they anything more than mere pleasure parties, with science as an excuse for their being held? It is true that no actual scientific work is done at the meetings. That must be reserved for the laboratory and the study. The week gives scientific workers a pleasant and congenial break, and an opportunity of bringing their results, in the form of papers at the various sections, before an interested and as a rule highly-intelligent audience. Then students and amateur scientists, if I may use such a term, meet with the real workers in the paths of science, and perchance catch a something of their spirit. I have heard several men who are now leaders in their respective branches state publicly that they have first been stimulated to work by attending just such meetings as these.

In conclusion, let me only advise the sceptical to take advantage of the opportunity which will be afforded next year when the British Association meets—practically at our own door—in Aberdeen, and see whether attendance at the meetings will not rouse them, and give them a new interest in the progress of science.

On the motion of Mr J. M'Neill, a vote of thanks was awarded to the delegates for their reports. He hoped that many members of the Society would act on the advice given them by Mr R. D. Pullar, and attend the meetings of the British Association, to be held in Aberdeen next year.

Mr JOHN YOUNG, C.E., in seconding the motion, recommended the Society to invite the British Association to visit Perth. He believed they could provide plenty of accommodation for the meetings of the various sections. If they made application they might be able to get the Association to come to Perth a few years hence. He thought they might instruct their President to keep this in view.

The following paper was read:—

"*Comparative Anatomy of the Teeth. I. Fishes, Reptiles, and Birds.*" By Mr James Stewart, L.D.S.

It is not my intention this evening to give a detailed description of the teeth of animals, but simply to draw the attention of the Society to some of the more peculiar and characteristic dentitions, hoping to awaken, in some of our members, an interest in the study of comparative anatomy. This, the most important part of zoology, is much neglected by us. We are content to know merely the name and external appearance of a specimen, and do not trouble ourselves to examine its internal structure and organization. Undoubtedly this neglect of anatomical investigation was the cause of many of the mistakes of the older naturalists. For example, it is not without difficulty that you can convince some people that such an animal as a porpoise is not a fish. They point to its shape and habitat, and these unimportant points are, to them, sufficient to fix its position amongst the animals; but the anatomist removes any doubt by showing it to have a four-chambered heart, warm blood, circular blood corpuscles, lungs, and many other structures which entitle it to a place in the highest division of the animal kingdom. Again, it seems almost incredible that two animals so different in external appearance and habits as a bird and a reptile should resemble each other in so many important points that they are placed in the same division, yet anatomy tells us that they are closely

related to each other by the formation of the lower jaw, its articulation not with the skull directly but through the intervention of a special bone, the articulation of the skull with the spine, position of the ankle-joint, and other points of structure.

Unfortunately, comparative anatomy has received a bad name. It is looked upon as an uninteresting subject, fit only for an enthusiast. There is some apparent foundation for this popular belief, but only when we begin the study in the wrong way. To read through a work on comparative anatomy is a severe task, but the difficulty disappears when we use the book simply as a signboard to direct our practical investigations. So important is this practical part for the derivation of the full benefit and pleasure from the study, that Professor Huxley, in his Introduction to the Study of Zoology, says that "unless the student intends to examine the various parts of the animal for himself, he had better shut the book." A little repugnance is felt at first in handling dead animals, but with a little determination this is easily overcome.

I have chosen for this evening's paper a small but not unimportant part of anatomy, and, with the aid of specimens, I hope to be able to show that it is not so uninteresting as some imagine. Before giving a description of the different teeth, it is necessary to have some idea as to what a tooth is, and of the structure of an ordinary tooth, as this will simplify what is to follow. To give a definition is always a difficult matter, and not less so where it appears easiest. We all know what a tooth is, but cannot tell another. It is a hard substance placed in or near the mouth, and is found only in the Vertebrata (the "teeth" of the Invertebrata are not the homologues of vertebrate teeth, but are frequently modified limbs). Teeth present a great variety of form and structure, and are used for seizing, tearing, pounding or dividing the food, as weapons of offence, means of anchorage, or aids to locomotion.

*Structure of a Tooth.*—A tooth is divided into three parts—1st, the crown or exposed part; 2nd, the fang, or part implanted in the jaw; and 3rd, the neck, or constricted part between the crown and the fangs. It is composed of three substances—1st, dentine, forming the body of the tooth, and surrounding the pulp chamber; 2nd, enamel, forming a cap for the exposed part; and 3rd, cement, covering the fang. These differ from each other in structure, dentine being formed of minute tubes running more or less regularly from the pulp outwards, enamel of irregular hexagonal prisms, and cement of a substance closely resembling bone and containing bone-cells. These tissues have a different arrangement in some animals, and all are not always present. Teeth, being the hardest parts of the body, are frequently the only remains of extinct vertebrates, and being intimately related to the food and habits of the animal, are of great value to the geologist in forming his classifications.

*Fish.*—The teeth of fish offer a greater variety in form, number, and position than those of any other class. In some they are as fine as hairs and almost as flexible; in others large, massive, and strong. Many fish, such as the common sturgeon, have no teeth; while others have thousands. In the latter case, they may be found on every bone entering into the formation of the mouth. There is a continual development during the life of the animal, new teeth replacing those shed or lost. The following are examples of some fish dentitions. In the lamprey *(Marsipobranchii)* there are no true calcified teeth, but simply horny cones. In the pike, teeth are carried on the intermaxillary, vomer, palate, and lingual bones, branchial arches, and lower jaw. Its mouth may be said to bristle with teeth. Amongst those on the lower jaw are some much larger and stronger than the rest. A pike seizes the bait with these large teeth, and retains it for some time before attempting to swallow it, and so firm is its hold that the angler frequently imagines the fish to be firmly hooked, but is soon disappointed to find it let go the bait. Any one who has been unfortunate enough to get his fingers entangled in the mouth of a living pike has had a very touching illustration of how small a chance of escape its prey has got. The structure of these large teeth is peculiar. Internally, they are composed of vasodentine, with a layer of unvascular, and covered with a transparent substance supposed to be enamel. In the sea-angler *(Lophius piscatorius)*, a fish with an enormous mouth and head and disproportionately small body, the teeth are larger than in the pike, and much curved backwards. The large teeth of the lower jaw are remarkable for the manner of attachment to the jaw. Instead of being anchylosed as in ordinary fish, they are attached along the posterior border of the base by strong ligaments. This allows the teeth to bend backwards but prevents their going in the opposite direction; and thus allows great freedom of entry to the prey, but effectually prevents its getting out again. The fish being very sluggish, it is necessary that when once it seizes its prey there should be no escape, and of this there is little chance. In the wolf-fish *(Annarrichas lupus)*, the teeth in the front of the jaws are strong, and project outwards, giving to the animal a savage appearance. Those at the back are broad and rounded. The use of these teeth is perhaps best explained by telling the contents of the stomach of one I examined. It was rather a miscellaneous collection. There were parts

of two varieties of sea-urchin, starfish, whelks, limpets, periwinkle, dog-whelk, &c. The front teeth serve to pull the shell-fish from the rocks to which they are generally adherent; the back ones, moved by the powerful masticatory muscles, crush the shells. In the sharks and rays *(Elasmobranchii)*, the skeleton is cartilaginous; the teeth can therefore never be anchylosed to the jaws. They are arranged in several rows along the margins and posterior surfaces of the jaws, and are implanted in a dense fibrous membrane. During life this membrane slides forwards over the edge of the jaw, carrying with it the rows of teeth. As soon as the foremost row reaches the outer edge it drops off, but by this time the one behind has come into its most effective position. New rows are continually developed to make good the loss. This perhaps explains why fossil sharks' teeth are so common, other parts of the animal being seldom found. Some of these fossil teeth are of enormous size, and if they can be taken as a guide to the size of the animals, former sharks must have been as large as whales. The teeth are mostly triangular; some being serrated. In the rays they are flattened, and carry a sharp point, the rows resembling mosaic pavement. The saw-fish *(Pristis)* resembles the above in its oral dentition, but projecting from the upper jaw is a broad spatula-shaped weapon, the rostrum, armed along each side with large teeth. These teeth are peculiar for their mode of attachment, structure, and growth. The rostrum sometimes attains a great size.

*Amphibia.*—The teeth are fewer than in the fish, and placed only on one or two bones, There is a continual succession. In the frog, teeth are found on the upper jaw and the vomers. The toad is edentulous. The labyrinthodon, a gigantic extinct amphibian, shows a labyrinth-like arrangement of the dental tissues, from which the name is derived.

*Reptiles.*—In the tortoises and turtles *(Chelonia)* teeth are absent, the jaws being covered with horn. The serpents *(Ophidia)* may, for convenience, be divided into two classes, the poisonous and non-poisonous. In the former the teeth are placed on the upper and lower jaws, the palate and pterygoid bones, forming 4 rows above and 2 below. They are sharp recurved cones, anchylosed to the bones; and are only useful for seizing and holding the prey, which is swallowed whole. In rachiodon, an African snake, which lives on eggs, the teeth are rudimentary, as large teeth would be liable to break the eggs, and some or all of the contents might be lost: but projecting into the gullet are bony processes from the under surface of the vertebrae, which, striking against the egg in its passage to the stomach, break the shell, and thus save the contents from being lost. Of poisonous snakes there are two groups, the colubrine and viperine. The cobra is a good example of the former. The fang, or poison tooth, is placed on the upper jaw, and is always erect; while a few small teeth are placed behind it. In the viperine snakes the upper jaw is much reduced in size, and carries only one long poison-fang. The fang is not always erect, but lies along the roof of the mouth, only becoming erect when the animal opens its mouth to strike its prey. The mechanism by which this is effected is thus described by Professor Huxley:—"When the mouth is shut the axis of the quadrate bone is inclined downwards and backwards. The pterygoid, thrown back as far as it can go, straightens the pterygo-palatine joint and causes the axes of the palatine and pterygoid bones to coincide. The transverse, also carried back by the pterygoid, similarly pulls the posterior part of the maxilla and causes its proper palatine face, to which the great channeled poison-fangs are attached, to look backwards. Hence these fangs lie along the roof of the mouth, concealed between folds of mucous membrane. But when the animal opens its mouth for the purpose of striking its prey, the digastric muscles, pulling up the angle of the mandible, at the same time thrust the distal end of the quadrate bone forwards. This necessitates the pushing forward of the pterygoid, the result of which is two-fold: firstly, the bending of the pterygo-palatine joint; secondly, the partial rotation of the maxillary upon its lachrymal joint, the hidden edge of the maxillary being thrust downwards and forwards. In virtue of this rotation of the maxillary through about a quarter of a circle, the dentigerous face of the maxilla looks downwards and the fangs are erected into a vertical position. The snake 'strikes' by the simultaneous contraction of the crotaphite muscle, part of which extends over the poison-gland, the poison is injected into the wound through the canal of the fang, and this being withdrawn, the mouth is shut, all the previous movements reversed, and the parts return to their first position." [The mechanism and action of the poison-fang were illustrated by an ingenious model, constructed by Mr Stewart.] In form the fang is long, pointed, and recurved. Passing through the tooth is a canal opening on the anterior surface near the jaw and point. This canal is really outside the tooth, and might be formed by bending back the edges of a flattened tooth till they meet. In the colubrine snake the canal is marked by a groove along its anterior surface. So large a weapon must run great risk of breakage from the struggling of the prey, and to be deprived of it

would subject the serpent to considerable inconvenience. When a fang is lost, however, another is almost ready to take its place on the opposite side of the same jaw; and there may be no less than five pairs in different stages of development to replace those that are lost. In the lizards the teeth are confined to the jaws and palate. In the crocodile they are found on the jaws only, implanted in sockets, and are formidable on account of their size and sharpness.

*Birds.*—No recent bird has teeth. In the merganser the jaws are serrated, and serve the purpose of teeth in preventing the escape of slippery prey. The discoveries of Professors Marsh and Owen, however, have shown that some extinct birds were well supplied with teeth.

The paper was illustrated by diagrams, preparations, and models.

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JANUARY 8TH, 1885.

F. BUCHANAN WHITE, M.D., F.L.S., President, in the Chair.

NEW MEMBERS.

The following were elected:—Major Dudgeon, Depute-Governor, General Prison, and Mr Wm. Anderson, Balhousie School.

The following were nominated for election at next meeting:—Miss Wippell, City and County Infirmary; Mr Wm. Roy, West Cultmalundie; Dr P. M'Iver Campbell, Perth District Asylum, Murthly; Mr James Dewar; J. Grahame, Esq., Sheriff-Substitute; and Mr John M'Intosh.

DONATIONS.

I. *Index Collection.*—Branch with cones of Cedar of Lebanon, grown at Airleywight—from Messrs Dickson & Turnbull; mineralogical specimens from Mr Galloway, Perth.

II. *Perthshire Collection.*—Three moles, three shrews, one water shrew, one long-tailed field mouse, six red field voles—from Mr D. Dewar, Remony, Kenmore; six long-tailed field mice, three squirrels, two stoats—from Mr W. Laidlaw, Castle Menzies; one jackdaw—from Mr W. Duncan, Almondbank; one hanging wasp's nest—from Mr C. Gibson, Pitlochry; one common hare (curious pale variety)—from Mr John Hood, Drummond Castle; one otter—from Lord Stormont, Scone Palace; one common rat and four rick mice—from W. Herd, Scooniehurn; pure white variety of common rat—from Lord Stormont; great black-backed gull—from Mr J. Forbes, Kilgraston; a large number of labels for the birds—from Colonel Drummond Hay; stoat and greater black-backed gull—from Mr Irvine, Dupplin; variously-coloured pearls from the pearl-mussel *(Unio margaritifer)* of the Tay—from Dr Buchanan White. (*Note.*—Specimens of white pearls are much desired to complete the series.) Black variety of common rabbit—from Mr P. D. Malloch, Perth; white variety of common sparrow—from Mr Black, Strathview.

III. *Library.*—"A List of Diurnal Birds of Prey," by J. H. Gurney—from the author.

The following papers were read:—

1. "*Comparative Anatomy of the Teeth. II. Mammalia.*" By Mr James Stewart, L.D.S.

In the mammalia the teeth are fewer in number than in fish or reptiles. They are always confined to the jaws, and there are never more than two sets. The perpetual replacement so common in fish and reptiles finds no parallel amongst the mammals. When only one set is present, the teeth, with few exceptions, very closely resemble each other; but when there are two sets they differ from each other in form and size. We are thus enabled to give the latter special names, as follows:—1. Incisors, the teeth implanted in the intermaxillary bone, and the corresponding teeth of the lower jaw. 2. Canine, the first tooth behind the intermaxillary suture, provided it is not far behind it (the under-canine closes in front of the upper). 3. Molars, those at the back of the mouth, which come up behind the first or deciduous teeth (these are generally broad and strong, and used for grinding the food). 4. Premolars, those in front of the molars, which have displaced deciduous teeth.

In past ages, the teeth of mammals were much simpler in form, and more closely resembled each other, and it was only by progressive modification and suppression that the dentitions have attained their present complexity. In a certain extinct animal, the *Homolodontotherium*, the incisors, canines, &c., pass by insensible gradations into each other, the adjacent teeth differing but little from each other. In

the typical mammalian dentition there are 44 teeth, divided as follows:—Incisors, 3; canine, 1; premolars, 4; molars, 3, in each side of both jaws. This number is seldom present in recent mammals with two sets; and where some are absent, it is generally possible by comparison with allied animals to tell which teeth are lost. The teeth are implanted in sockets, not anchylosed to the jaws; and the articulation is called *gomphosis*, from the resemblance to a nail driven into a board.

Mr Stewart then gave an account of some of the more remarkable types of mammalian dentition, taking the various groups in their order, and exhibited in illustration a large number of interesting specimens.

2. "*The Diatoms of the Tay.*" By Dr Trotter.

Of the many forms of organic life which come under the observation of the microscopist, none prove more attractive than diatoms. Their almost universal distribution, their elegant forms and beautiful and regular ornamentation, their great variety, and the ease with which they can be procured and mounted for observation and preservation, make them at once favourites with all who are in possession of even the cheapest of microscopes. To the naturalist, also, they are of great interest as occupying a position on the border between animal and vegetable life. They are among the most widely-distributed organisms we know of, and they play an important part in the economy of the universe. They are found in all running waters, and their skeletons, or shells, are found in every geological formation, from the gneiss that was formed on the very eve of creation, to the mud that is being deposited by the Tay this afternoon. Mountains are formed entirely of their remains, deposited in ages long gone by, and the fertilizing mud now being spread over Egypt by the overflow of the Nile, is largely composed of them. Our own Tay owes its superiority, as a salmon river, chiefly to its superabundance of diatoms, which furnish food for the many forms of life, which eventually result in the monarch of the waters. Anyone walking on the banks of the Tay in summer, and examining its pebbles, must have observed the thick muddy encrustation which envelopes every peeble on its shores. This crust is almost entirely composed of diatoms and their gelatinous envelopes, mixed with entangled clay and sand, and from it were obtained most of the diatoms which I shall show you to-night.

When in the south-west of England this autumn I remarked that in the Rivers Urr, Ken, and Dee scarcely any of this crust was to be found, and in what there was, diatoms were few and small, there being not one per cent. of what there are here. Curiously enough, though there appears in the Solway to be much better marine feeding ground than in the small estuary of the Tay, the salmon are very much smaller, a 20 lb. fish being chronicled in the local papers as "another monster," while here a fish of double that weight would scarcely secure mention.

Diatoms may be considered as little transparent cases composed of silica, and of various forms, from a cylinder or half-globe, to a long, thin, narrow stripe with square ends. They are almost always symmetrical, both in figure and in the stripes, checks, and hexagous with which their surfaces are adorned. Some kinds, instead of being in the form of cases, have two parallel flattish ornamental surfaces, connected down the centre by a vertical plate, somewhat like a portion of a railway plate, and giving a transverse section resembling in appearance a dumb-bell. Diatoms appear to multiply chiefly by self-division, as many of the lower forms of life do, but, though the fact is not yet established, they appear also to increase by spores, as we find many sizes of the same variety in the same particle of mud, some perhaps 1-100th, and some less than 1-1000th, of an inch in length. We find also that a small stream has to trickle over a rock for only a few days, when the rock becomes covered with countless millions of these minute organisms, a circumstance only to be accounted for by supposing the germs to have been deposited there by the water.

The waters of the Tay and its tributaries are very rich in diatoms, and I have already picked out and mounted over a hundred distinct forms. There is great difficnlty in naming most of them, as very few correspond altogether to the typical forms. Indeed, they seem to differ in form in almost every tributary stream, and even in the Tay itself changes of form are found every few hundred yards. The diatoms of high water also are different from those of low water, and those of the stream from those from still water. A great many well-known British forms, however, are found, as well as other forms which I have not been able to identify. Diatoms are divided into two principal sections,—those which have no central nodule or true median line, and those which have a median line and a true central nodule,—both of which are well represented.

[After exhibiting and describing some of the species found in the Tay, Dr Trotter referred to those which occur in a fossil state in the clay beds of the district, as follows.]

Strange to say, their shells are as beautiful and perfect in every respect as if they had lived and died

but yesterday, and they will endure as perfect as ever long after the name of tbe Fair City is forgotten. I have no doubt many of our members have observed a series of sandy ridges extending, with various interruptions, almost round the basin of wbich Perth may be considered the centre. These sandhills are very conspicuous at High Craigie, wbere they have been extensively used for building purposes. They are also very prominent at the bead of Friar Street, in the New Town, the new Board School being built on one of them. On the eastern side of the town they are well seen at Kincarrathie and Pitcullen, and on both sides of the city they maintained an elevation of about 50 feet above the present sea-level, and mark the shores of a former arm of the sea, very much resembling some of the West Highland marine lochs. At about 10 to 15 feet lower than those sandhills there is in several places an extensive bed of brick clay, the former sea-bottom, which, in several spots, sloped gradually up so as to be left dry at low water. On the clay of the deeper parts of tbis ancient bottom being examined with the microscope, very few diatoms are found, but the silicious spicules of marine sponges are found in great numbers,—a portion of clay about the size of a pinbead containing on an average about ten of them. These, I need scarcely say, could get there only by tbe sponges living and dying there, or their remains having been washed there by the waters of tbe ocean. Those of you wbo have been at seaside places wbere the shores were flat and marshy, will be familiar with wbat are called inks or merse-holes—little pools in tbe salt marsbes, which do not fill up with clay, and into whicb the sea flows regularly. Such places once existed on the west side of Perth, and it is from one of tbese ancient inks that I got tbe old world diatoms. At the top of tbe old Higb Street, near the site of St Catherine's Chapel, a drain was cut for some new buildings now being erected, and tbe drain passed through two deposits of dark blue clay, quite different in appearance from the yellowish clay by which tbey were surrounded. This clay so mucb resembled the clay beside my native village that I took portions of it and the yellow clay bome, and on examination I found the blue clay teeming with diatoms altogetber different from tbose of the Tay, and, with two exceptions, exclusively marine or brackisb water forms, while the yellow clay contained a few of tbe same diatoms and very numerous sponge spicules. The clay at different deptbs contained different forms, as if the life of each particular kind depended on some certain depth of water. A short time after this I was on the shores of tbe Solway Firth, and found tbe inks there at the present day containing precisely similar diatoms—some exactly alike and otbers sligbtly modified.

Tbe city of Pertb, therefore, is built on beds of clay teeming with millions of these interesting objects, whicb, though trivial and unimportant in tbemselves, are valuable and interesting to the student of natural history, as pointing out in unmistakable terms some of the great geological changes to which our country has been subjected, and also by indicating to us the inconceivable beneficence of Divine Providence, in bestowing so much beauty in form and ornamentation on objects so minute that man with unaided eye could never bave so much as suspected their existence —objects whicb, tbough so minute and so low in tbe scale of creation, existed in innumerable forms long before man came into being, wbile their silicious skeletons will last as perfect as ever long after man has disappeared from the earth.

A large number of specimens were shown by tbe aid of tbe microscope.

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January 22nd, 1885.

## CONVERSAZIONE.

A conversazione was held in the Museum buildings in Tay Street, at which a large number of the members and their friends were present. Tbe cbief attraction was the Museum, where the newly-arranged cases were inspected witb great interest. The cases of Perthshire birds, and particularly that containing the nests and eggs, were especially admired. Some of the members who bave taken a more active part in tbe arrangement of the various collections explained the general plan of the Museum, and drew attention to tbe points of special interest. In tbe Lecture-Room a number of microscopes were on view in charge of members, wbo exbibited collections of objects in all departments of natural science. Among the more attractive of tbese were a number of living diatoms from the River Tay, as well as other forms of microscopic plant and animal life, and some beautiful sections of the crystalline rocks of tbe neigbbourbood shown by aid of the polariscope. A novel aid to microscope work was exhibited by Mr J. Campbell, optician, in the form of an exceeedingly small electric light, known as the "midget" lamp, wbich

answered the purpose of a microscope lamp admirably. Tea and refreshments were provided for the visitors in the Library.

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FEBRUARY 7TH, 1885.

F. BUCHANAN WHITE, M.D., F.L.S., President, in the Chair.

NEW MEMBERS.

The following were elected:—Miss Wippell, City and County Infirmary; Mr Wm. Roy, West Cultmalundie; Dr P. M'Iver Campbell, Perth District Asylum, Murthly; Mr James Dewar; J. Grahame, Esq., Sheriff-Substitute; and Mr John M'Intosh, Perth.

The following were nominated:—Miss Douglas, Barossa Place; Mr Dan Wylie, Muirton Bank; Dr G. Galletly, Perth Infirmary; Mr James Proudfoot, South William Street; Mr W. Rutherford, Strathmore Street, Bridgend; Mr David Keir, Comely Bank; Mr Dow, Methven Street; Mr Peter M'Gregor, National Bank; Mr Thos. M'Gregor, Tay Street; Mr W. A. Barclay, Savings Bank; and Mr Thos. Moncrieff, Balhousie Street.

Mr D. Dewar, Remony, Kenmore, and Mr George Alexander, St Paul's Square, Perth, were nominated as Associates of the Society on the recommendation of the Council, on account of services rendered.

DONATIONS.

The following were intimated:—

Index Collection:—Bark of tree, grown in Yosemite Valley, California, American onyx, and specimens of American silver ore and pumice stone—from Sir R. D. Moncreiffe, Bart.

Perthshire Collection:—Stoats—from Captain D. M. Smythe, yr. of Methven, and Mr D. Dewar, Remony; specimens of red voles, long-tailed field mice, and house mice—from Mr Athole M'Gregor, Eastwood; white jackdaw—from Mr Geddes, Bridge of Earn; common hares and mole—from Mr W. Laidlaw, Castle Menzies; large wasp's nest—from Captain D. M. Smythe, yr. of Methven; common shrew and red field-voles—from Mr D. Dewar, Remony; falcon—from Mrs Robertson of Struan; weasels—from Mr D. Dewar, Remony; field voles and common shrews—from Colonel Drummond Hay, Seggieden.

EXHIBITIONS.

Mr H. Coates exhibited the following:—

1. A specimen of the Snail-slug (*Testacella haliotidea*, Drap. var. *scutulum*). This interesting slug was forwarded to Mr Coates by Mr W. D. Sang, C.E., Kirkcaldy, who found it in the St Brycedale Nurseries, in that neighbourhood. This was the first time the species, or indeed the genus, had been reported as a native of Scotland, its most northerly habitats previously known to zoologists being Yorkshire and North Durham. It is common in France and Southern Europe, and in England is found chiefly in the southern counties. It has been known to Mr Sang to occur in the St Brycedale Nurseries for six or eight years; so that if, as is probable, it was accidentally introduced with nursery plants, it has now thoroughly established itself in the locality. It frequents the boxwood borders, and is very seldom to be seen, except in early morning during wet weather in spring and autumn. The specimen had been verified by Mr W. Denison Roebuck, of Leeds, the leading authority on slugs. Mr Coates then pointed out some of the remarkable peculiarities of structure and habit which distinguish this from all other genera of slugs. It lives chiefly on earthworms, which it pursues through their burrows. Its shape is specially adapted for this, being long and worm-like itself, and its breathing organs are situated at the extremity of the tail, and covered by a flat external shell to protect them from injury in crawling through the burrows. Its teeth also are strong and recurved, to enable it to seize and hold its prey.

2. A fractured shell of the common banded snail (*Helix nemoralis*), which had been repaired by the mollusk in a remarkable way. Shells that have been damaged and repaired are of frequent occurrence, but the peculiarity of this specimen consisted in the last whorl having been entirely displaced, so as to present the appearance of one shell growing within another, though it had been mended in such a way that the inside of the shell presented an even surface. The specimen was found at Invergowrie during one of the excursions of the Society last summer.

3. Contorted specimen of the fresh-water coil-shell (*Planorbis vortex*), from Errol. This is normally a perfectly flat coiled shell, but in the specimen exhibited

the last whorl was bent abruptly to one side, and quite detached from the previous whorl.

Dr Buchanan White exhibited a large spider (Mygale) from Cuba, presented to the Index Collection by Mr H. Crawford, Kinvaid. Some specimens of Mygale, he said, attained a much larger size, and were able to catch and kill small birds.

The following paper was read :—

"*Shells: Their Structure, Growth, and Uses.*" By Mr H. Coates, F.R.P.S.

I cannot commence this paper on shells without referring to the loss which science has sustained in the death of Dr J. Gwyn Jeffreys, who passed away within the last few days, at the ripe age of 76. Dr Jeffreys has spent almost a life-time in throwing light on the habits and distribution of the mollusca of our coasts, and of the neighbouring seas, and his *British Conchology*, in five volumes, is the most important and comprehensive work we have on the subject. He was one of the most constant attendants at the meetings of the British Association, and conducted several dredging expeditions organised by its Committee. With him the study of natural history was pre-eminently a labour of love. In proof of this I need only quote one sentence from the work above referred to :—"The study of our native mollusca has been to me from childhood such an inexhaustible source of pleasant and innocent occupation, it has given me so many happy hours, and it has taken away or alleviated the sting of so many sorrows, that I am desirous to assist in making it more an object of general cultivation than it has hitherto been."

In former papers I have given some account of the anatomy and physiology of the two great classes of the mollusca which are represented by our local land and fresh-water shells. In these papers the shell itself came in for a share of description along with the other parts of the organism, but necessarily only a very brief and partial description. My present object is to look a little more closely into this the most popular part of molluscan anatomy. Popular the subject certainly is, and yet I trust we shall find that shells are not merely attractive to the casual observer, but offer to the student of Nature some of the most curious and interesting problems with which he has to deal. Without a knowledge of the creatures that formed them, and of the way in which they were formed, the mere shell-fancying which has been dignified with the name of "conchology" can lead to no results beyond the accumulation of a cabinet-full of objects which are curious or rare, and nothing more; but with this knowledge, each specimen has a lesson to teach us.

Without further introduction, let us ask ourselves what a shell is. The question seems a simple one, and yet it is by no means easy to answer. It is part of the work of the comparative anatomist, in studying any particular organ, to endeavour to discover its relationship to similar organs in forms of a different type, both as regards its structure and its use; in other words, to find out its homology and its analogy. Let us try, therefore, to define the shell of a mollusk in terms of this two-fold relation. As regards its homology, the definition must be negative rather than positive, for a shell is one of those structures which do not seem quite to correspond with anything we find in either higher or lower types of the animal kingdom. The most we can say is that, as a skin-secretion, it corresponds to such appendages of the skin as hairs and feathers. At first sight it might appear to be homologous with the shelly covering of a crab or lobster, but the differences of type and structure are wide, as we shall presently see. The analogies of the shell are much more obvious. Here we have the true correspondence with the armour of the crab, as also with the limey framework of other invertebrates, whether external or internal. The analogy between a shell and the skeleton of a vertebrate is marked, as both serve not only as supports for the soft parts of the body, but as mechanical means of attachment and leverage for the muscles. Thus, as we can bring our finger and thumb together by means of the muscles which are attached to the bones of these limbs, so the oyster can close its shell by means of the muscle which connects the valves. For this reason, therefore, the shell may be described in general terms as the *exo-skeleton* of the mollusk. When, however, we come to compare the shells of different groups of mollusca, we find that it has further a special end to serve, namely, to protect the breathing organs and heart. One proof of this is that the most rudimentary shells, namely, those of the slugs, are in general merely thin plates of limey material covering these organs; and in one slug, the *testacella*, where the breathing organs are removed to the extremity of the body, the shell is still found associated with them. The development of the shell also is closely connected with that of the heart and breathing organs. For these reasons the shell has been called a pneumo-skeleton. There is one exception to this relation, namely, in the "paper nautilus," but the structure and origin of that beautiful shell are altogether so abnormal that it need hardly be taken into account.

We are now perhaps in a better position to answer our

original question of what a shell is. We may define it generally as a hard external covering peculiar in its structure to the sub-kingdom Mollusca, and serving at once as a support and a protection to the mollusk, or, as Tryon has expressed it, "A dwelling-place and a citadel." There are two points that I would ask you particularly to bear in mind: first, that the shell is part of the animal—that is, that they are organically connected, and cannot be separated without causing the death of the animal; and, second, that at no stage of the animal's development is the shell cast off and a new one formed, as is the case with the covering of the crab or lobster. The connection may be said to be partly a vital and partly a mechanical one. Thus there are muscles which extend from the animal and enter into the substance of the shell at certain points, and a framework of animal matter runs through the whole structure of the shell; but, on the other hand, only the parts of the shell most recently formed can be said to be possessed of vitality, and no part possesses in itself the power of repair. This is proved by the fact that if it is bored or broken in such a way as not to injure the animal, the break is not repaired; but if the animal is wounded at the same time, then a fresh secretion of shelly material takes place to repair the damage. The shell is present in embryonic form from the earliest stage in the mollusk's history; but in the so-called naked forms, it is lost as soon as the creature emerges from the egg. It is probable that all mollusks, with the exception of the argonaut, possess a rudimentary shell when hatched.

So much, then, for what a shell is. Let us look next at how it is made. The greater part of the body of a mollusk is enveloped in a loose fold of the skin, called the mantle, which is tolerably thin and transparent, except at its outer margin, where it is thickened into a kind of collar. This mantle is the part of the animal which builds up the shell. The precise manner in which it does this work is not fully understood, and what is known of the process is perhaps rather difficult to follow, but I shall make it as plain as I can. The margin of the mantle corresponds to the outer or growing edge of the shell, and its general surface lines its interior. The main structure of the shell is built up by the former, which adds layer after layer of material to the growing edge, while the general surface of the mantle adds its smooth inner lining, and thus serves to increase it in thickness. This thickened margin of the mantle consists of minute cells of a certain type, known as epithelia, which have the power of separating from the blood, as it passes through them in the course of its circulation, certain mineral as well as animal substances, of arranging these in definite form with mathematical exactness, and of adding the material thus elaborated to the growing margin of the shell. The structure is thus literally built up layer by layer, prism by prism. I said that animal as well as mineral matter entered into its composition. This is proved if we place a shell in an acid which will dissolve the latter but not the former. After it has lain in the acid for some time, all that remains is a delicate spongy framework of animal tissue, exactly corresponding to the shape of the shell. This may be considered as the foundation or basis of the structure on which the solid material is encrusted, as it were. I think we may therefore look on the shell as a kind of duplicate of the mantle, gradually thrown off by itself in greatly attenuated form, but correspondingly strengthened by earthy particles deposited in intimate association throughout its tissues. When we find, further, that the mantle encloses the breathing chamber and heart, you will understand why it is that the shell is looked upon as specially a protection for these organs. The general outer surface of the mantle is found to consist of cylindrical cells, which have the power, as already stated, of forming layers of mother-of-pearl or nacre. Some mollusks, however, have the power of completely enveloping the shell in the mantle, and of thus adding a smooth layer to the outer as well as to the inner surface. This is the case with the cowries and olives, whose shells many people fancy to be polished by artificial means, though in truth no human agency could produce such an exquisite gloss.

Shells are almost invariably enveloped in a thin skin or covering of animal matter, known as the epidermis. This is secreted by the margin of the mantle, and is formed at the same time as the main substance of the shell—not, as might be supposed, added afterwards, layer by layer. Thus it is always freshest on the parts of the shell last formed, and is frequently found to be entirely worn off the older parts. It may be looked upon as an outer layer of the shell, in which the framework of animal tissue is not hardened by limey particles. In most marine species it is exceedingly thin, like a mere coating of varnish, but in those inhabiting brackish or fresh water it generally becomes thick and horny. Its use is to protect the mineral substances of the shell from the corroding action of the water, or rather of the carbonic acid contained in it. It is found to exist even on the internal shells of slugs; and in the cowries, just referred to, it occurs *underneath* the outer glossy coating.

Passing from the question of how the shell is formed, we have next to ask what it is made of. Except in two comparatively small groups, the hard parts of shells are composed of carbonate of lime, together with a small percentage

of other mineral substances. In this they differ from such structures as the bones of vertebrates, the eggs of birds, or the armour of the crab, in which phosphate of lime forms the chief mineral basis. The proportion of animal to mineral matter differs in different species, but in marine shells the former may be estimated roughly at about one-tenth, while in land shells it constitutes nearly one-fifth of the whole. I have already mentioned that the cells of the mantle separate the mineral matter out from the blood, but the question may be asked—how does it come to be in the blood in the first instance; in other words, whence does the mollusk derive its supply of lime? I reply, from the plants on which it feeds, or, if it be an animal-feeder, from the plants on which these animals in turn have fed. For our present purpose this might be considered a sufficient reply, but I may be allowed a slight digression in order to trace the process from an earlier point—I do not say from its *earliest* point, for it presents us with one of those "stories without an end" of which the economy of Nature furnishes so many examples. Far back from the sea-shore, on the mountain's side, you may have watched the beginnings of some tiny stream, and have speculated on the vicissitudes it would have to undergo before it came to rest at last in the great ocean, but you may not have reflected that this was one of Nature's countless laboratories, in which she was preparing the needful stores for the myriad forms of animal and plant life contained in that ocean. Yet so it is. The rain, as it descends through the atmosphere, and as it soaks through soil composed of decaying vegetable matter, drinks in a supply of carbonic acid, and, thus charged, percolates through the pores of the rocks, dissolving the lime from them as it goes. Therefore, when if comes to the surface again as the spring on the hill-side which forms the fountain-head of the mountain stream, it is the bearer of an invisible store of mineral wealth, and as it flows along, and joins with other streams to form the brook and then the river, it constantly dispenses this store of lime to plants and animals which either live in its waters or derive their supplies from it indirectly. When it comes at last to the sea, it delivers up this burden to the mollusks, the coral polyps, the microscopic foraminifera, and the hosts of other creatures that build up a limey framework. These creatures, receiving this invisible carbonate of lime through the medium of the plants on which they feed, are able to convert it into the visible bi-carbonate of lime by the addition of a further atom of carbonic acid in the microscopic laboratories of their cells. On parts of the coast which are not fed by streams, and where the rocks of the shore themselves do not contain lime, we find that shells are either very scarce or absent altogether, and frequently those that are present are thin and fragile, owing to the scarcity of building material. For the same reason, land shells are always more abundant and better developed in districts where lime is plentiful either in the rocks or in the soil. I have more than once been astonished in exploring a Highland glen to come upon large numbers of snails in a comparatively small area, until I found that this area marked the outcrop of a bed of Silurian limestone. It seems to be doubtful whether mollusks derive their lime exclusively through the medium of food-plants, or whether they have to a certain extent the power of assimilating it direct from the water or from the rocks, but certainly by far the greater quantity is derived by the former means.

Returning once more to the growth of the shell, you may ask—how are all the beautiful colours and markings and patterns to be accounted for? These, too, are the work of the minute cells composing the fleshy edge of the mantle, by means of which the mollusk, by a marvellous provision of Nature, can separate out different colour pigments from its blood, can arrange them in a certain definite order, often of great complexity, and can add these to the walls of its dwelling during the building process. But to my mind far more marvellous is it that each species should decorate its shell, not at random, but, with slight variations, in the same way that its progenitors decorated theirs. The colouring matter is generally confined to the outer layer of the shell, but in some the deeper parts are coloured also. This is the case with the various species of *Cassis*, whose shells are composed of variously-tinted layers, ranging from white to pink, claret or chocolate, as the case may be. It is by carving these different layers that the Italian cameo-cutter can produce such exquisite effects. The intensity of the colour of shells depends greatly on the amount of sunlight they receive. Hence the brilliant hues of tropical species, and hence also the comparatively colourless shells of mollusks which live at considerable depths of the ocean.

Some interesting questions arise in regard to the relation of the forms of shells to their growth. As you are aware, almost all shells are either univalve or bivalve; that is, consist of one piece, or two pieces. The former, moreover, constituting about three-fourths of the whole molluscan sub-kingdom, are generally spiral in form. Now, if we suppose a spiral shell to be made plastic, and to be uncoiled, we shall have a tube tapering to a closed end, or, in other words, a cone, more or less drawn out. A cone, then, is said to be the type or plan upon which univalve shells in general

are built up, and the simplest example we have of this is the common limpet. It is the consideration of the way in which a limpet constructs its conical shell that gives us the clue to the construction of the more complex spiral forms. In this mollusk the collar of the mantle adds to the margin of the shell equally all round, simply enlarging its radius as the creature increases in size. But supposing the front of the mantle were to be more active, and to build faster, so to speak, than the back, what would happen? The front portion of the shell would increase at a greater rate than the back until it curled round upon the latter, and thus in time a flat spiral would be formed, such as the familiar ammonite. But let us suppose, further, that in addition to this the activity of one side is in excess of that of the other. We have then two influences at work, and it is a mere matter of calculation to ascertain that the resultant of these two forces will be a spire not coiled flat, but more or less drawn out, or, in mathematical phrase, a spire whose plane is constantly changing. It is thus that the infinite varieties of spiral forms originate, varying from the nearly plane Harpa or Ampullaria to the tapering spire of Terebra or Mitra. Probably it is the position of the heart in the different species which determines this variation of form, as mollusks with reversed shells are found to have the position of the heart reversed also. If this be the true explanation, it affords a curious example of the connection which is sometimes seen between the working out of a mathematical law and a purely physiological cause. Almost all spiral univalves have the spire turned from left to right, but there are some species, and even one or two genera, in which the reverse is the case. Of the former, however, it is by no means uncommon to find deformed specimens in which the shell has taken the opposite to the normal turn. This sometimes occurs with the common garden snail, and other land species. It is curious to note that while one species of whelk common on our coasts at the present day (*Fusus antiquus*) has normally a dextral or right-turn shell, in a fossil state, as it occurs in certain deposits in the south of England, it has normally a sinistral or left-turn shell. The creature has, therefore, undergone in the course of ages a curious physiological modification, so that what was formerly the exception is now the rule, and *vice versa*.

Many spiral shells exhibit characteristic marking, such as raised plates or spines, which occur at regular intervals on each whorl. These mark periods of special activity of the mantle, occurring at definite intervals of time. The spiney murex is a good example of this; and if one of its spines be examined it will be found to consist of a hollow tube, not quite closed along one side, showing that it was formed within an extended fold of the mantle. In addition, however, to these special growth-marks, which may be compared to the annual rings in a tree stem, all shells are more or less marked with what are called "lines of growth," which mark the steady progress of the building process, without indicating any definite period of rest or activity.

The shell does not continue to grow during all the life of the mollusk, but after maturity has been reached it increases in thickness only. Most univalves, also, when they attain their full growth, have the lip greatly strengthened by an outer rib, and sometimes ornamented as well by the addition of spines or other processes. A familiar example of the latter among our native mollusca is the "pelican's-foot" shell (*Aporrhais pes-pelicani*), which derives its name from this peculiarity, while its gigantic tropical cousin, the *Pteroceras*, is merely an exaggerated example of the same. I have said that the mollusk thickens its shell after it has attained maturity, but a remarkable exception to this occurs in the case of one or two genera, which actually dissolve away part of the inner partition walls of their shells in order to increase their accommodation. This only occurs with forms such as Conus and Oliva, whose shells are so closely coiled as to leave very little space for expansion. The inner wall is not entirely removed, but is reduced to the thinness of paper.

I find that the limits of this paper will not permit me to say anything about the microscopic structure of shells, which forms an interesting study in itself. There are other points also, especially in regard to the shells of bivalves and of cephalopods, to which I should like to have referred, but I fear I have taxed your patience too far already with what, to many, must appear dry details of structure. My only excuse is the unfailing pleasure which the study of these objects has always yielded me, and the desire to lead some to look upon them not as mere toys, but as among the most beautiful and wonderful pieces of workmanship in God's world. It has sometimes been urged against the study of natural science that much of the charm and poetry of Nature is lost to the naturalist as he learns to look beneath the surface of the objects he sees around him, and to enquire into the how and wherefore of their existence; but I trust I have said enough to show that, in the case of shells at least, the pleasure of a ramble by the seaside will not be diminished but greatly enhanced by such a study, if entered into in the right spirit.

MARCH 5TH, 1885.

*ANNUAL MEETING.*

F. BUCHANAN WHITE, M.D., F.L.S., President, in the Chair.

NEW MEMBERS.

The following were elected :—

Miss Douglas, Barossa Place; Mr Dan Wylie, Muirton Bank; Dr G. Galletly, Perth Infirmary; Mr James Proudfoot, South William Street; Mr W. Rutherford, Strathmore Street, Bridgend; Mr David Keir, Comely Bank; Mr Dow, Methven Street; Mr Peter M'Gregor, National Bank; Mr Thos. M'Gregor, Tay Street; Mr W. A. Barclay, Savings Bank; and Mr Thos. Moncrieff, Balhousie Street.

The following were nominated :—

Mr John Moncrieff, Hay Street, and Mr John Livingstone, Barossa Place.

The following were elected Associates, in recognition of services rendered to the Society :—

Mr D. Dewar, Remoney, Kenmore, and Mr George Alexander, St Paul's Square, Perth.

DONATIONS.

The following were intimated :—

*Perthshire Collection.* From Mrs Robertson of Struan—peregrine falcon; from Mr D. Dewar, Remoney—weasel (spotted below) and field-vole; from Colonel Drummond Hay—field-vole and two common shrews; from Mr F. Stanley Maude, Coldstream Guards (per Colonel Drummond Hay)—one great black-backed gull (young); from Mr T. Richmond, Hilton—snow-bunting; from Mr T. Marshall, Stanley—weasel and common field-vole; from Mr P. D. Malloch, Perth—fungus.

*Index Collection.* From Captain Macdonald, St Martins—alligator skin; from Mr T. Marshall, Stanley—yellow rabbit; from Mr Macgregor—crab.

ELECTION OF COUNCIL FOR 1885–86.

The following were elected office-bearers and members of Council for the Session 1885–86 :—

F. BUCHANAN WHITE, Esq., M.D., F.L.S., *President.*

JOHN MACGREGOR, Esq.,
JAMES STEWART, Esq., L.D.S.,
R. D. PULLAR, Esq., F.C.S.,
Sir ROBERT MENZIES, Bart., } *Vice-Presidents.*

S. T. ELLISON, Esq., *Secretary.*
JOHN STEWART, Esq., *Treasurer.*
Col. H. M. DRUMMOND HAY, C.M.Z.S., *Curator.*
JAMES COATES, Esq., *Librarian.*
HENRY COATES, Esq., F.R.P.S., *Editor.*

R. DE BRUCE TROTTER, Esq., M.D., L.R.C.P.E.,
JOHN YOUNG, Esq., C.E.,
R. BROWN, Esq., R.N., } *Councillors.*

REPORT OF THE COUNCIL.

The Council, in presenting the Eighteenth Annual Report, has to congratulate the members on the continued prosperity of the Society.

During the past session 6 ordinary meetings were held, the average attendance at which was 30, being about the same as during the previous session. At these meetings 7 papers (in addition to shorter communications) were read, the number of authors being 6.

During the past year eight long excursions were made, particulars of which will be found in the "Proceedings." As in former years, the best thanks of the Society are due to those landowners who for these and other excursions kindly gave permission to go over their properties, and otherwise assisted in making the excursions successful. As several lady-members have expressed a wish to join in the excursions, but have thought that these are usually too long for them, the Council will endeavour to make arrangements this year to suit all members.

To the roll of the Society 32 new names have been added during the past session. The membership of the Society is now 329, including 2 Honorary and 8 Corresponding Members, and 9 Associates.

As an experiment, the Council invited the members and their friends to take part in a conversazione on January 22. The experiment having proved highly successful, the Council will have under consideration the advisability of repeating it next session.

From the increase in the number of specimens received for the Museum, it was found necessary to have a number of new cases constructed, in consequence of which the Museum had to be closed to the public for a period of about 3½ months. During the 8½ months since last annual meeting that it has been open it was visited by upwards of 7000 persons. The total number of visitors since the opening in December, 1883, is nearly 15,000.

The Council have to notice with regret the retirement from

the office of Honorary Secretary of Mr John Young, C.E. Mr Young was elected to the office in 1871, and has discharged its arduous duties during a critical period with untiring solicitude, and with great benefit to the Society. The very hearty thanks of the Society are due to Mr Young for his valuable services.

During the past year the Council have had pleasure in granting the use of the Lecture-Room to some other Associations for courses of lectures and meetings.

The Council has held 8 meetings during the past session.

In conclusion, it may be mentioned that Mr Hosack Cowan having been obliged from pressure of other duties to resign his post as Janitor, the Council selected, out of a large number of applicants for the vacant situation, Mr James Wilson, who has given every satisfaction.

### REPORT OF THE CURATOR.

By Colonel DRUMMOND HAY.

In giving in my report as Curator for the past year, I may state that a good deal has been done for the better display of the specimens, especially in the Perthshire and Tay district collections, and many additions made in the several sections. The Museum, as most of the members will recollect, was closed for a good part of the summer, during which time a series of new bird-cases were erected, extending along the side looking towards the river; while on the opposite side the cases for the Perthshire Forestry Department were also completed, leaving the south end of the hall entirely for mammals. This entailed the total re-arrangement of the birds as well as the mammals, giving space also for the nests, but only as a temporary measure, as these will require very much more room. Consequently no attempt has been made as to any systematic arrangements, but the labelling, which will shortly be completed, will so far rectify this, by the numbering and reference to the birds in their several compartments, so as to enable the student to ascertain their regular classification. I think it proper here to mention that, notwithstanding the new cases which have been added, to complete the fauna of the district it will be requisite to increase the size of the Museum by an additional hall. This will be absolutely necessary to represent fully the Natural History of the district, the cases being even now in many respects overcrowded.

### REPORT OF THE LIBRARIAN.

By Mr JAMES COATES.

Since last report about 80 volumes have been added to the Library through exchange, purchase, and presentation, the totals being now approximately 350 for the Lending and 170 for the Reference Library, making in all about 520 volumes. During the past year the number of members who have taken advantage of the Library has fallen off, being only 34, as against 46 during the previous year. This is to be regretted, as it was hoped that, with an increased membership, the Society would be able largely to extend the sphere of its usefulness in this direction as it is doing in others. In case there should be any misconception on the part of members, especially those recently elected, as to their privileges, it may be mentioned that any member not already provided can receive a library catalogue gratis on application to the Janitor, and the names of all books added to the Library since that catalogue was issued will be found inscribed on the wall-board in the Library. There appears to be no reason why the number of readers should not be at least doubled, as there must be a large proportion of the members of the Society who, in their choice of literature, would be glad to combine scientific instruction with amusement if they once realised how easily this combination lay within their reach.

### REPORT OF THE EDITOR.

By Mr HENRY COATES.

During the past session, the only publications issued by the Society were the fourth annual part of the "Proceedings" and a Guide to the Arrangement of the Museum. It is intended to supplement this guide in the course of time by issuing detailed catalogues of the various collections.

### REPORT OF THE TREASURER.

By Mr JOHN STEWART.

The income for the year amounted to £79 0s 5d, and the expenditure to £77 14s 5d, leaving a balance in the Treasurer's hands of £1 6s. There is at present £30 11s 8d of outstanding accounts due by the Society. To meet that sum there is about £6 of arrears of subscriptions and £11 6s in bank and on hand, so that the Society is only about £13 behind. It is anticipated that there will be a saving in expenditure of from £10 to £12 next year.

On the motion of Mr R. BROWN, Barnhill, seconded by Mr ANDREW COATES, the reports were adopted; and on the motion of Mr G. ROY, Savings Bank, seconded by Mr LUMSDEN, Superintendent of Fisheries, a cordial vote of thanks was awarded to the retiring officebearers for their services during the year.

### ANNUAL PRESIDENTIAL ADDRESS.

Dr BUCHANAN WHITE delivered the following address:—

Since the last occasion—thirteen years ago—on which I had the honour to fill the presidential chair at an annual meeting, the Society has passed through many and important changes. To slightly alter the words of the old Roman I may exclaim that I left the Society brick, and find it marble! Then we met in obscure corners; now we have a building of which any Association might be proud. But at all times and under every circumstance the Society

has kept steadfastly in view the objects for which it was founded; and if we are now able to rejoice in the prosperity we have attained we must not forget that hard work in the past has conduced to it, and that it is only by hard and earnest work in the future that we can hope to retain it.

During the past year nothing of paramount importance has been recorded in the annals of the Society. The reports that have just been submitted to you show that it is in a prosperous condition, though there is room for the wish that our Treasurer had been able to announce a larger balance in favour of the Society. It must be admitted that the Museum is a heavy tax upon our income. With the object of making the advantages the Society offers available to as many persons as possible the annual subscription has been fixed at as low a rate as it can well be. Amongst the special privileges of members the Museum cannot be included, for, as we have opened it free of charge to the public, its benefits are as accessible to persons who are not members as to those who are. But since the upkeep of it must be defrayed by the subscriptions of members it is desirable that our membership should if possible be increased, and we ask therefore all who are interested in our experiment of a "Free Museum" to assist us by joining the Society. They will find in the library, &c., an ample return for the small subscription required.

There is one matter in the reports that I cannot pass over in silence, and that is the resignation of the gentleman who has so creditably held the office of Secretary for the past eleven years. As a member who has, perhaps more than any other, come in contact with Mr Young in his capacity as Secretary, and as knowing from personal experience what the duties are, I may be allowed to express the feeling of full appreciation that the Society has of Mr Young's services during a trying period of its existence, and its gratitude for the manner in which they have been given.

And now, following the example set by my predecessors of late years, I must ask your attention to a few words about the present condition and possible future of our Museum. We have heard from the report of the Council that, during the eight and a-half months during which the Museum has been open since this time last year, it has been visited by upwards of 7000 persons. What the motives of these visitors were we cannot, of course, say, but we shall probably not be wrong in thinking that the motive of the majority was no higher one than intelligent curiosity; whilst a few were actuated by the desire of acquiring information. That some visitors come for the latter reason, seems to be really the case, as the same names occur again and again in the "Visitors' Book," a fact that is suggestive that the visits were repeated for the purpose of continuing a study of the specimens. In attributing these motives to the visitors to our Museum, I do not of course claim for it any peculiarities not possessed by other museums. A gentleman who has had much experience in connection with the Liverpool Free Museum (an institution which, though supported by a public rate, owes its existence, like our own more modest establishment, in great measure to private munificence) has recently stated that out of every thousand persons who pass through the museum, 10 to 20 are students, 780 are interested observers, and 200 are loungers. Now, though of course we prefer visitors who come for purposes of study, I need not say that we are glad to see every visitor, be his motive what it may in coming, for, as has been said of certain other persons—"Those who came to scoff remained to pray," so possibly amongst the many individuals who are led into the Museum by curiosity only, some may be induced, from what they see there, to become students of those sciences for the study of which the Society was founded.

But apart from this hope we ought to be glad—for another reason—to see so many visitors. The primary and most important object of this Society in forming the Museum was, of course, to afford easily accessible means of education in natural science—instruction not only in natural science as a whole, but more particularly as regards the Natural History of Perthshire. In short, our aim has been to supply to the citizens of Perth instruction in a branch of education for which no other means are provided, and regarding which the following words of Ruskin are still unfortunately too true—"The whole force of education, until very lately," says Mr Ruskin, "has been devoted in every way to the destruction of the love of nature. The only knowledge which has been considered essential is that of words, and next of abstract sciences; while every liking shown by children for simple natural history has been scrupulously limited to hours of play, so that it has really been impossible for any child earnestly to study the works of God but against his conscience; and so the love of Nature has become the characteristic of truants and idlers." Yet, though the promotion of this branch of education (not for children only but for adults as well) is, as I have said, our primary object, there is, apart from that altogether, another reason why we should be glad to see so many visitors to the Museum. In this changeable climate, it is not always possible to spend a holiday in the open air, and as there are but few indoor places of amusement, it sometimes happens that a wet holiday is not always spent in a very profitable manner. By providing a place, therefore,

where a few hours may be passed at least inexpensively and harmlessly, I think we will not be considered as claiming too much if we say that the Society, by means of its Museum, is doing a good work.

To return, however, to our proper subject. As you will remember, we did not enter into possession of this building till the end of 1881. At that time we had not in hand many museum specimens, for though in its earlier days the Society had been getting from time to time examples of the local animals and plants, yet from the want of accommodation it did not make any great efforts to form a collection until after the present building had been acquired.

After the building was ready for occupation cases had to be made, so that it was not till towards the end of 1882 that the arrangement of the collections could be begun, while another year elapsed before the Museum could be opened to the public. It will thus be seen that it is barely three years since the formation of the Museum may be said to have really commenced. That in these three years we have not been idle the following census of the number of specimens will show:—In the Index Collection there are upwards of 2000 specimens (including models and drawings), of which about 900 belong to the Geological Index Collection, 400 to the Botanical, and 700 to the Zoological. In the Perthshire Collection we have about 15,000 specimens, belonging to 1712 species, out of about 2300 species known to occur in Perthshire.

The following table shows how these are apportioned among the different groups :—

| Group. | Total Perthshire Species. | Species in Museum. | Specimens in Museum. |
|---|---|---|---|
| Mammals, | 39 | 26 | 100 |
| Birds, | 219 | 169 | 329 |
| Birds' Eggs, | 111 | 62 | 420 |
| Birds' Nests, | 111 | 48 | 92 |
| Reptiles and Amphibians, | 8 | 6 | 15 |
| Freshwater Fishes, | 23 | 18 | 48 |
| Marine Fishes, | | 11 | 14 |
| Land and Freshwater Mollusca, | 58 | 54 | 3604 |
| Lepidoptera, | 849 | 447 | 2085 |
| Flowering Plants & Ferns, | about 900 | nearly all | about 8000 |
| Native Timber Trees, | 19 | 19 | 197 |

In the above table, the figures in the first column must be taken as indicating the number of Perthshire species so far as at present known, and in some cases only approximately. The remaining species of mammals we are not likely to get soon, as some are now extinct in Perthshire, and among the others are 6 or 7 species of whales which have been found, but very rarely, at the mouth of the Tay. The 319 species of birds include those of the whole basin of the Tay, and of the total, 9 or 10 are of very rare occurrence. The number placed opposite the nests and eggs (111) indicates of course the number of birds known to breed in the district. In regard to the collection of fishes, it is only quite lately that we have determined to include the fishes of the mouth of the Tay, as belonging really to the fauna of the basin of the Tay. The collection of mollusca includes specimens of 36 varieties of the 54 species represented. Of the 849 Perthshire Lepidoptera, 431 belong to the Macrolepidoptera and 418 to the Microlepidoptera. The collection of the latter is by far the most deficient, and I take this opportunity of pointing out the absence of many common species.

In addition to the specimens enumerated above there is also the nucleus of our Geological Collection (which has not yet had much attention paid to it), including 166 specimens; and we have also a considerable number of unarranged specimens of the other orders of insects and other invertebrate animals, and of the cryptogamic plants, amounting in all to several thousand additional specimens. That the latter remain unarranged is due to several causes, but chiefly for the reason that the time and energies of those members by whom the Museum has been arranged have been fully occupied by the work that has been done. Those who inspect the Museum will see that a large amount of time and labour must necessarily have been expended on the arrangement, but unless they have actually taken part in it, it is doubtful if they can really estimate the amount of each that has been given. Let me —with an ulterior object in view—endeavour to sketch briefly the work that has been required in one department alone. Let us take the birds, since they not only form a conspicuous feature of the collection, but are the special charge of the Curator, whose devotion to the museum work has been second to that of none. In the first place, and before anything could be done, a competent knowledge of the classification, and an acquaintance with the characteristics of the species, would have had to be acquired, had not the arranger of this department possessed these in an eminent degree already as the result of life-long study. In the next place the principles on which the arrangement was to be made, an idea of the space required, and of the room to be allocated to each family, had all to be planned out. Then, to obtain the necessary specimens, much labour had to be expended in the preparation of lists and in correspondence with persons likely to be able and willing to render assistance in procuring examples of the birds. After the specimens had been obtained instructions had to be given for their preservation, if the arranger did not undertake this also himself (and in all the departments the arrangers have

done work in this direction). Then when the specimens had at last reached the Museum they had to be mounted on their appropriate stands; labels had to be prepared and attached (and, as you know, the labels gave much more information than the name of the species merely); the legs and beaks of the birds had, in many instances, to be painted the natural colours; and, finally, the specimens had to be placed in their proper places in the case, a work which sometimes entailed the re-arrangement of those which had been previously placed in position.

And as with the birds, so with the other collections. The amount of work that has been necessary for each can only be really appreciated by the arranger. Now I have not been entering into these details with the view of extolling the work done, or of seeking the thanks of the Society on behalf of the workers. The Society, I know, is perfectly willing to thank the arrangers to their hearts' content, and if it were not so the pleasure that the work has afforded them would be sufficient reward. The labour has been a labour of love, and the work has not been the less well done because it has been done gratuitously. In fact, if we had had to employ paid curators, it is not improbable that the Museum might not have been so far advanced, and yet cost the Society in salaries several hundred pounds a-year.

But the reason why I have been expatiating on the work that has been done is that the question of extension of the space available for specimens is now becoming urgent. Many of the cases are as full as they can hold, and objects that ought to be exhibited are either not shown at all, or are so crowded together that they are not shown properly. In the present hall, wherever a case could be put it has been put, and so if the Museum is to be what it ought to be, an extension of the building is absolutely necessary. As, unfortunately, our available funds are now exhausted, it may seem to some persons that to discuss the question of extension without the means of carrying it out is more or less a waste of time. Against this view it may be urged that, as the question must be met some day or other, the present is the proper time to do it, when those who are most intimately acquainted with what is necessary and desirable are fresh from the work of arranging the collections, and on that account are at present best qualified to give advice on what form the extension should take, when it is possible to carry it out. Moreover, if we can ascertain what extension is necessary and practicable, and what the expense thereof would be, there seems a greater probability of it being done sooner than if we postpone discussing the question till funds have been obtained, and content ourselves with the vague statement that some extension is desirable.

With the object, therefore, of utilising the experience gained in the work of arranging, I asked Mr Young to prepare the plans which are now laid before you.

We have, fortunately, ground behind this present building, ample enough for all the extension required, so that no outlay is necessary to acquire a site.

The main features of the new building are a large hall on the ground floor; another of the same size, but with a gallery round it, on the first floor; the extension of the present laboratory as far as the back wall of our ground; a curator's room above the laboratory; and dwelling-rooms for the janitor above the curator's room.

Let us now consider, in detail, the purposes to which each of the additional apartments would be devoted. The hall on the ground floor, which would have an area of nearly 1000 square feet, should contain the Index Collection. At present this collection is necessarily in our one hall, and, apart from the fact that the space that it is possible to allot to it is rather too limited, it seems impossible to get visitors to understand that it is distinct from the Perthshire Collection. To the new hall the present table cases (in which the Index Collection is chiefly contained), could be removed, and, in addition, the walls would be surrounded by cases, while in the middle of the floor a few narrow, upright cases would be placed for specimens in fluid—the need of such cases being very much felt in our present Museum. By confiniug the Index Collection to one room (which would be entirely restricted to it), all risk of confusion with the Perthshire Collections would be avoided; and, moreover, by the additional space the educational value of the collection could be very much increased.

With reference to this Index Museum another idea occurs to me, namely, that, if at any time our sister Association—the Literary and Antiquarian Society—should be at a loss for room in which to exhibit its natural history specimens, some arrangement might perhaps be come to, by which we could take care of them on behalf of the other Association. This would do away with the anomaly of having two museums in Perth,—one entirely, and the other partly, devoted to natural history,—and would permit our friends to show their antiquarian, technological, and art collections to full advantage. Of course, any specimens thus placed under our care could be reclaimed at any time.

The hall on the second floor would have an area of nearly 1000 square feet, and be surrounded by a gallery with nearly 700 square feet of area. Both the hall and

the gallery would be devoted to the Perthshire Collection. In the hall could be placed the Perthshire birds and birds' nests. To these the wall cases would be allotted, giving a perpendicular superficies of 812 square feet, in comparison with the 500 square feet of the present cases. This would probably be an ample allowance (though not too much) for all time coming. The central floor space of the hall would be occupied by table-cases, cabinets, and narrow upright cases for the collection of the Perthshire invertebrate animals.

The gallery would be surrounded by wall-cases (of 812 square feet perpendicular superficies) in which the Perthshire Geological Collection could be displayed, as well as those botanical specimens which are too bulky, or otherwise not suited, for the herbarium. The herbarium itself could be kept in the Curator's room, where there would be much greater facilities for examining and studying the specimens.

Finally, the present Museum Hall having had the Index and Ornithological Collections removed from it, would afford the much-needed space for the Perthshire mammals and fishes. (Regarding the latter a word of explanation is required. The fishes of Perthshire proper are not so numerous in species as to require much space, but as the small part of the River Tay that is not in Perthshire ought certainly, from a scientific point of view, to be taken along with Perthshire proper, and as this has been done with regard to the birds, it seems but right to do the same with the fishes, &c. It is perhaps a little difficult to determine where—in the faunistic sense—the Firth should end, but after consideration it seems advisable to include as much of the sea as lies within the Bell Rock. With this extension of our district the number of species of fish that have to be represented in the collection is much increased.) To sum up. The suggested additions to the Museum space (not including the extended laboratory, Curator's room, &c.) would give an area of 2614 square feet, which, added to the present area, would make a total of 3846 square feet. Of wall cases the additional perpendicular superficies would be 2408 square feet, or, with the present, 3720 square feet.

We now come to the very important matter of the expense of these suggested improvements. Of these it is estimated that the building would cost £850. It is difficult to estimate the cost of all the cases, but taking the wall cases, which would form by far the greater part of what is required, and calculating the expense of them at the same rate as those we have already, the outlay would be about £500, which sum, however, would exceed what is necessary, as expense might be saved in several ways. Roughly estimating the expenses of the other cases, it is probable that altogether a sum of £1500 would be sufficient, not only for building, but for furnishing purposes. At the same time it is not necessary (though perhaps desirable) that the cases should all be put up at once. If we had enough money (say £1000) to erect the additions and furnish the hall on the first floor, it would be a great gain to the Museum, and the other parts of it could be left more or less unfinished and unprovided with cases till more money was obtained. At the same time the additional apartments would not be useless on such occasions as conversaziones or other large meetings.

However, as matters are at present, it seems unnecessary to say much more on this point. My object has been to show what extensions are desirable, if not absolutely necessary. The Society now knows what its museum requirements are, and what funds must be provided to carry them out, and, having ascertained so much, the first step has been taken.

Before finishing it seems expedient to point out that, though the space in the Museum for the exhibition of specimens is becoming restricted, we do not, on that account, wish donations to cease. We shall continue to place in the cases all the examples for which room can be found; and as for the others we have accommodation for keeping, though not for exhibiting, them, till the desired extensions are made. It must not therefore be thought that more specimens are not required in the meantime. The very contrary is the case, and we will always be glad to receive donations either to the Perthshire or to the Index Collections. The Perthshire Collection especially — though wonderfully extensive considering the short period during which it has been made—is in need of many specimens, before it can be termed anything like complete. We wish specimens not only of those species which are as yet unrepresented in the Museum, but additional examples of species that we have already, in illustration of the changes produced by age or season, as well as to show the distribution throughout the district. In connection with the latter point it may be mentioned that it is in contemplation to eventually publish catalogues of the various groups of Perthshire animals, founded upon the specimens we have in the Museum. I call them catalogues, but in reality we hope that they will be much more than mere lists, and be in fact exhaustive treatises on the fauna of the county. To accomplish this, however, we must have trustworthy information about the distribution and local variation of the different species, and the best way to get this information is by procuring specimens from every part of the district.

And now, in conclusion, one word of warning to the Society. It has sometimes happened—instances can be found throughout Britain—that a Society which has formed a Museum has eventually sunk into the position of being merely the custodier of the Museum, and has, otherwise, to all intents and purposes, ceased to exist. Let us be warned in time, and never fail to keep in mind that the Museum is only an adjunct to the Society, and one means among many of accomplishing the objects for which the Society was founded.

Colonel DRUMMOND HAY, in moving a vote of thanks to Dr Buchanan White for his address, said that what he had stated with regard to the desirability of extending the Museum was quite the case. He only trusted that the members of the Society would take the matter up in the way it should be, so that ere long they might see the additions to which Dr White had referred completed, because if it were done in the days of those who had been at the founding of the Museum they would be better qualified to see it properly completed, or at least put in the proper way for completion, than any strangers would be. He thought it would be a great thing to try and get it started at all events. As they no doubt were all aware, the Society had sufficient ground for the purpose at the back of the present buildings, if they only had the money.

Mr JOHN STEWART, in seconding the motion, said that every one admitted the desirability of the extension being made. Dr White had remarked that it was a very important thing to know the expense, but it was a much more important thing to know where the money was to come from.

Mr ANDREW COATES said that he saw nothing in Dr White's remarks which indicated that the Society were prepared to go into the matter without money. Dr White, he considered, had rendered a great service to the Society in bringing forward the matter, and in making the suggestions which he had done. Dr White merely looked upon this as being the first step towards what might possibly become ultimately a very great benefit to the Society. The matter must be ventilated in the first place. Unless the public knew that the Society really desired an extension of their Museum, it was not likely they would take any interest in the matter. If it was brought before the public, he had no doubt but that there were many parties who, realising the great advantages that the Society was likely to confer, would assist them in getting up the means with the view at all events of making a commencement to the extension of the Museum, in order that the Society might thoroughly accomplish the objects it had in view. The extension, he thought, was absolutely necessary. They could not begin too early to ventilate this matter, and let the public know they wanted an addition to the Museum in order to make it valuable for the purposes of education. The Society was one which was gaining very much in public favour, and was looked upon as one of the most valuable educational Institutions in the city.

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## APRIL 2ND, 1885.

F. BUCHANAN WHITE, M.D., F.L.S., President, in the Chair.

### NEW MEMBERS.

The following were nominated:—Mr R. Stewart Menzies of Hallyburton and Mr Leslie Macdonald, St Ninian's School.

The following were elected:—Mr John Livingstone, Barossa Place; and Mr John Moncrieff, Balhousie Terrace.

### DONATIONS.

The following were announced:—

I. *Perthshire Collection*—Swan, from Sir Robt. Menzies, Bart.; water vole, from Mr D. Dewar, Remoney; water vole, from Mr T. Marshall, Stanley; Rhagium (a beetle), in its burrow, in a piece of wood, from Colonel Colquhoun of Clathic; shell of *Cyprina Islandica*, from Mr J. Stewart.

II. *Index Collection*—Young pigeon, with malformation of head, from Mr L. Horsfall, Perth; rat, with abnormal teeth, from Mr Cairns, Balthayock.

The CHAIRMAN said that he had also much pleasure in announcing that the "Duncan Trustees," in reply to an appeal made to them by the Council, had very generously given a donation of £150 to the Society's funds, and he moved that a special vote of thanks be given to the Trustees for this renewed expression of appreciation of the way in which the Society's work had been carried on.

### EXHIBITIONS.

Dr F. BUCHANAN WHITE exhibited the skull of a rat which he had prepared from a specimen sent by Mr Cairns, gamekeeper, Balthayock, to Colonel Drummond

Hay. In the papers on the teeth of vertebrate animals read by Mr James Stewart at the beginning of the session, the peculiarities of the cutting teeth of rodents were pointed out, especially the way in which the upper and lower teeth work against each other, and are thus kept a proper length. In the specimen exhibited, the result of a want of apposition in the teeth was well shown. Some accident having happened to the lower right jaw, the teeth (with the exception of the lower right incisor) had continued to grow till they attained an inordinate length, and, in the case of the upper ones, had almost formed rings, while the injured jaw had become much diseased. The result to the unfortunate animal was that what little food it could partake of must have been sucked in, as there was no possibility of its using its teeth. The specimen afforded a good illustration of the character of rodent incisor teeth, namely, that during the life of the animal they continue to grow at the root end, and to be worn away at the free end. The latter, being softer on the inner side than it is on the outer, has thus a chisel-like edge always kept ready for use.

The following papers were read :—

1. "*The Climate of the British Islands, with special reference to Perthshire.*" By the Rev. A. Campbell, Errol.

The peculiarities of the climate of the British Islands are due to a very great extent to their geographical position. To the eastward of us we have the Continent of Europe, where, as a general rule, the barometer is high in the winter and low in the summer months; and to the west of us there is the Atlantic Ocean, where the barometer is low in the winter and high in the summer. It is to the fact that we lie between these two areas of differing pressure, that we owe the many and rapid changes which occur in our climate, and that we find it so difficult to forecast the weather for more than a single day.

The shape of the British Islands has also not a little to do with the climate. The winter temperature of Scotland, especially in the northern counties, is greatly modified by the fact that it is everywhere in close contact with the ocean ; and as a consequence, the average January temperature of Sumburgh Head or Stornoway is equal to the average temperature of the same month at Yarmouth or London. In the present year, indeed, the figures for January show results for the north of Scotland, as compared with the south of England, remarkably favourable to the north, so far as temperature is concerned. At Sumburgh Head the mean of the maximum temperatures of January this year was 42·1, and the mean of the minima was 34·4. At Stornoway the mean maximum figure was precisely the same as at Sumburgh Head, and the mean minimum of the month was 34·7. Now, contrasting these figures with those which apply to a few of the stations in the south of England, the difference is very marked. Thus in London the mean of the maxima in January last was 41·3, and the mean of the minimum 32·5 ; and at Cambridge the figures were lower still—39·8 the mean of the maximum and 29·7 the mean of the minimum ; and even at Hurst Castle, which is in the extreme south of Hampshire, just opposite the west end of the Isle of Wight, the mean of the maxima of January was 40·3, or nearly a degree lower than Stornoway, and the mean of the minima was 34·1, or half-a-degree lower than Stornoway. But it must be remarked, that the deficiency of heat in January of this year has been much more marked in the south of England than in Scotland; for while the minimum of January is below the average minimum of that month by 3·4 degrees at Hurst Castle and 3·9 at Scilly, Stornoway was 0·5 above the average in its minimum. January was therefore a good deal below the average in the extreme south, but not colder than the average in the far north.

But if the isothermal lines stretch north and south in January, they do not long continue in this abnormal condition. In February there is a decided recovery of temperature in the south, while in the north, especially in those places which are in contact with the sea, the temperature is about stationary at its lowest point ; and in the month of February this year, the difference between the temperature in the north and south is intensified by the fact that in England, especially in the southern counties, February was much warmer than the average, London and Oxford being both 3·4 above the mean, while Stornoway and Wick were 1·7 and 1·5 below the mean. In February of this year, therefore, the isothermal lines took the form which they usually assume in March, and stretched across our islands nearly from east to west. But this divergence from the ordinary rule was again rectified in March, when the temperature, below the average everywhere, was especially low in the south, and the mean of the minima at Cambridge was 2·9 degrees lower than the mean of the minima at Wick.

In the summer months, our insular position, and the facility with which the ocean breezes get access to all our stations, not only reduces the mean temperature of July and August everywhere within our islands, but makes the Scotch mean summer temperature very much

lower than the mean of the south-east of England. Thus the warmest part of England in July is included within a semi-circle with a diameter of 20 miles, stretching to the south and south-west of London, and thereforo including nearly all Surrey, the greater part of Berks, and part of Kent and Middlesex, where the mean of July is 64·4; but in Scotland the isothermal line of 58 in July skirts the Mull of Cantyre, and goes nearly due north through Argyll and Inverness to the Moray Firth, where it turns sharply to the east, and leaves Scotland a little to the north of Aberdeen: and so rapid is the decline in mean temperature to the north of that point, that Shetland only reaches 55. It may be noted that we in Perthshire enjoy an average summer heat in July of a little over 59, though it must be confessed that the temperature of every month of July in succession since 1880 has failed to come up to the average in our part of Scotland, and in the years preceding 1880, the July of 1879 and again of 1877 were both grievously deficient in summer heat. Taking the average of years, however, as our standard, we in Perthshire enjoy a mean temperature higher than the average touched at any town of the extreme north of Scotland during about three months from June 15th till September 15th. But to compensate for this, the mean of Perthshire sinks below the mean of Wick or Stornoway from about the middle of November, and it does not again rise to its level till the beginning of March; so that our range of temperature in Perthshire is very considerably greater than that of the northern counties of Scotland, being as much as 4½ degrees higher than Shetland in July, and nearly the same figure iu August, but fully 2 degrees lower than Shetland or the Hebrides in January. But while this is made as a general statement, it must be borne in mind that any statement which should embrace the whole of Perthshire would be far from simple, and would be complicated with many details. Thus the winter temperature of Eastern Perthshire is decidedly higher than it would otherwise be because of its proximity to the German Ocean; and, again, the summer temperature of the Carse of Gowrie is lower than it might be but for the same cause. In settled calm summer weather, it is no uncommon thing in the course of a journey by railway from Dundee to Stirling or the west, to start with a cool breeze of east wind, which follows the traveller up the Carse, though with continually decreasing force, till near Auchterarder a belt of calm is reached; and a little to the west, west winds are met. But the mean temperature of a summer afternoon in the Carse of Gowrie, when a cool breeze is blowing in from the sea, is very different from the mean of some inland districts, even though it should be in the uplands, when calm and light airs from the warm west blow instead of the bitter east.

But perhaps a more important and a more interesting feature of the climate of Perthshire is its rainfall, in respect of which there is perhaps a greater difference between the eastern and the western districts of the county than there exists between different parts of any other county in Scotland. Striking a general average, the annual rainfall in those parts of Strathmore near Perth, and down to the boundary line with Forfarshire at Invergowrie, is not much more than one-third of the rainfall which descends on the part of the county which lies between the County March with Argyll in the west round to about the head of Loch Earn in the east. The reason of this is not far to seek, for the conditions which favour the heaviest rainfall within our islands are an elevated tableland with projecting points of lofty mountains jutting up above it, as, for instance, in the Dartmoor region of the south of England; the Lake district in the north-west,—which enjoys the heaviest rainfall of our islands;—and a portion of North Wales; and these conditions are also met with in the elevated tableland which is near the meeting-point of the counties of Argyle, Perth, and Stirling. The numerous mountain peaks wring out the moisture from the clouds which float over them, mostly from the west, and the rain of course falls to leeward, giving Western and part of Central Perthshire an abundant supply of rain. But as the clouds drift eastward they have all the moisture wrung out of them, and they pass over Eastern Perthshire without sending down more than slight showers. On the other hand, Eastern Perthshire gets its heaviest rains with easterly winds. A good example of this occurred in December, 1876, during which month a constant series of depressions passed over the north of England, giving almost incessant easterly gales, with rain or snow; so that the rainfall of that month in Eastern Forfarshire and Perthshire was nearly everywhere over 10 inches,—the heaviest rainfall of any month in these parts within this generation,—but in the usually wet West of Scotland it came a long way short of being the wettest of months. Or to take a case nearer us in time. On last Sunday, the 29th ult., a shallow depression crossed over the North of England, and in consequence easterly breezes with cold rain were experienced in Scotland, but the rain in the east was far heavier than elsewhere. Thus Leith had 0.80 of an inch and Dundee 1.08 of an inch, while Glasgow had but 0.12 and Ardrossan 0.14 of an inch. It thus appears that were it not for the passage of depressions to the south of us, the East of Scotland, and with it Eastern Perthshire, would have much less rain than it has;

but Western Perthshire depends rather for its rainfall on the passage of the main stream of depressions which come from the Atlantic, and pass over towards Norway to the north of us, and experience shows that the rain from this source may always be trusted to be copious.

Dr BUCHANAN WHITE, in moving a vote of thanks to Mr Campbell for his paper, remarked that it would be very desirable to publish in the Society's "Proceedings" each year a summary of meteorological observations in the county, and also a statement of the forwardness or lateness of the season in regard to vegetation.

Mr Campbell agreed to undertake the compilation of such a record, and the matter was remitted to the Council for further consideration.

2. "*On Some Fresh-Water Annelids.*" By Professor Allen Harker, F.L.S., Royal Agricultural College, Cirencester, Corresponding Member.

On our dry oolitic Cotteswold Hills we have very few running streams, and our farmers depend for a supply of water for their stock on pools dug in the soft cream-coloured stone, in which the rain water accumulates. These pools are capital collecting grounds for the student of the indigenous invertebrate animals, as well as of the fresh-water *algæ*, and since every field (or at least every two or three fields) has a common pond, the collector has never far to go to reach his hunting-ground. One phenomenon that invariably attracts the attention of my students, and furnishes us with a subject for a half-hour's talk, is that exhibited by the presence in those pools of an innumerable concourse of one fresh-water annelid, the little red worm, probably the *Tubifex rivulorum* of Lamarck. I have sent a diagram with a much-magnified drawing of the creature, side by side with some details of its anatomy. Owing to its habit of living in the mud at the bottoms of ponds and streams, at a depth which ranges within very narrow limits, it is always distributed in our pools so as to form a ring right round the pool, at about (generally) a foot from the edge of the water. The ring itself is often not more than from 1 to 2 inches in thickness. I don't know that this fact of its existing only at a certain depth has ever been described before. But it is worth recording, and that it is due to some conditions affecting the animal is certain, because in chance pools left by a prolonged period of high rainfall, where the depth of the pool is the same all over, the whole of the surface of the mud at the bottom will be occupied by the annelids, while, on the other hand, where the bottom gently shelves down to a considerable depth, as in our artificially-formed pools, they are rigidly confined to a concentric area of narrow width.

Now the brilliant purple red colour which they have when seen densely massed together, shading off into a pink hue at each edge of the ring where they are less tightly packed, renders them a very conspicuous object, especially as seen contrasted against the soft ochrous colour of the mud in which they live. Add to this, that when you approach the edge of the pool to get a better view of the singularly brilliant ring of colour, the whole almost instantaneously fades away, first of all immediately opposite to you, but gradually all round the pond, as if by magic, and you have this singular phenomenon, which never fails to cause the greatest astonishment when first seen. The almost instantaneous disappearance of the colour is of course due to the fact that the annelids have felt the vibration of your approaching feet, and taking the alarm have hastily withdrawn themselves from a fancied danger into the depths of the mud. The rate at which the vibration is communicated might be calculated by the speed with which the ring of colour disappears at the furthest side of the pond. Sometimes we amuse ourselves by approaching the pool, simultaneously on all sides, and then at a signal all stamping together, when the ring disappears all at once. After an interval of as little as a minute, the blush of colour rises again on the mud, and in two or three minutes at most the annelids are all out again, as densely congregated as before. My students have experimented with long rods fixed in the pond, and vibrated at a distance, but all their results only serve to show that the annelids are extremely sensitive in the matter of touch, and bury themselves deep in the mud on the slightest disturbance. When we wish to collect specimens of the worms for closer inspection, we do not find it quite so easy as, from their immense numbers, you would imagine. If we try by dipping a collecting bottle into the mud and then filling it, we find generally that we have got nothing at all but mud and water. The worms retreat so far into the mud that our bottle does not reach them. We generally take a deep bag-net, and drag it through the mud till it is filled. We carry the bag full of mud to the laboratory and put it into shallow dishes or tanks, covering it with two or three inches deep of water, and leave it for some hours to settle to clearness. We then find that the worms have accommodated themselves to their new position, and are waving their bodies from side to side,—the anterior half protruding from the surface of the mud, the posterior buried in it. In our laboratory tanks we can repeat all the experiments made on a larger scale by the side of the pond. For ex-

ample, a shake to the table or shelf on which the tanks stand, or a tap on the vessel with the finger-nail, is enough to cause them all to disappear beneath the surface, from which, however, they emerge in less than a minute, and continue their regular wavy motion. In the laboratory tank or dish it is just as difficult to isolate and get out a single specimen as it was to get them from the pond. I have often got an individual into the end of a glass dipping-rod, but on withdrawing the finger from the other end of the rod, instead of the worm being "sucked" into the tube, it dives instantly into its hole and declines to be captured in that way. To isolate specimens it is necessary to wash the mud away under a continuous flow of water, and leave them high and dry on a plate or shallow dish. They can then be examined under chloroform in the usual manner with the live-box or the compressorium.

In this short paper I do not propose to treat of their anatomy at all, but to confine my brief remarks to one or two additional points in their habits. The worm has been described very fully by many observers. By Bonnet, who first noticed it; by Claparade, who is *facile princeps* in all researches on worms; by D'Udekem, who has written a splendid monograph of this species in the Transactions of the Royal Society of Belgium, while several of our own naturalists—Ray Lankester and M'Intosh—have added to what was already known about its anatomy and its reproduction.

In order that you may understand the diagrams, I will merely remark that it varies in length from one to three inches; that in thickness it is about 1-12th of an inch in diameter, that its blood is red, and its intestines appear through its transparent skin of a rich olive green or brown colour; and that its several segments bear four rows of setae,—"feet" we call them in familiar language,—by means of which it moves so briskly in the medium in which it lives.

I will also add that in your own streams and ponds it is equally common as with us, but because the bottoms of your ponds and streams are darker in colour than our oolitic mud, the contrast in colour between the worm and its surroundings is not so striking. Still you may find it in myriads by careful search. The first time I ever made its acquaintance was in a Scottish stream where it occurred on a narrow strip of the bed on one side for more than *half a-mile in length.*

I have kept this *Tubifex* in my laboratory tanks for more than three years, and have thus had very good opportunities of studying it. My observations are still going on, and I do not yet know so much about it as I should like to do, but I think I have settled one point in its habits which may interest you. Bonnet, who first studied it, said it made tubes in the sand of streams in which it lived. Lamarck gave it the name of "Tube-fashioner" from this habit. D'Udekem says they inhabit the bottoms of brooks; prefer running water and a sandy bottom; *construct tubes*, in which they hide entirely with great rapidity. M'Intosh repeats this, and adds that they occur sometimes under stones in very damp situations, making permanent burrows for themselves, as we see earthworms do under similar circumstances.

Now I came to the conclusion some years ago that *Tubifex rivulorum* did not make tubes at all, and my observations on it since then, made almost daily during the spring and summer on specimens kept under the most favourable conditions, in tanks with stagnant water and in tanks with running water, have led to a confirmation of that view. Whenever in our pools we stir up the mud with a spade or a stick, we should undoubtedly destroy the tubes of the worm if there were any—but what do we find? However vigorously we may rake the mud, a few minutes is sufficient lapse of time to enable the worm to emerge from the mud and appear as though nothing whatever had happened. On washing out the individual worm in the manner already described no trace whatever of the slenderest of tubes is to be found. What then has led previous observers to fancy that this little annelid was a tube-maker? I have forwarded a second diagram, which has been drawn by one of my students partly from a little sketch by D'Udekem, but also from directions suggested by the aspect of the living worm in confinement, and it will serve to explain, I think, one reason for the supposition that it is a tube-maker. You notice a number of worms projecting from a surface of vegetable matter and mud, represented as moving from side to side. Around each worm, just where it leaves the mud, is a little hollow cone of decayed vegetable matter almost like an inverted funnel, and this you might at first sight take for a tube. It is probably just such an appearance as led Bonnet to say it was a tube. But if you were to violently agitate the vessel in which these cones are formed,—even turn it upside down (if it be a bottle) and give it a good shaking,—you will destroy all the inverted funnels, you may reduce everything but the worms themselves to impalpable mud and debris, but as soon as the water clears again you will remark that the worms have survived the process, and have quietly resumed their habit of waving about half in and half out of the mud. What is more important, however, you will notice that the formation of these little cones is again proceediug, and that it is due to the slowly-falling particles of vegetable and other matter which arrange themselves around the moving worm. I have

artificially produced similar cones; so I am persuaded they are a mechanical result and not a physiological one, which a true tube would of course be.

Another observation puzzled me for a long time. In gatherings from the bottom of our botanic pond, largely occupied by *Tubifex*, which were kept in large wide-mouthed specimen jars, I noticed that after a few days what appeared to be real tubes projected from the surface of the mud sometimes to the height of half or three-quarters of an inch. They were brown and not unlike the cones in my diagram, but the aperture—or, if I may so call it, the bore—of the tube was of a diameter very much greater than that of the body of the worm. I almost began to think that they might be worm-tubes after all, but by carefully watching them I soon discover the fabricator. It is the well-known blood-red larva of *Chironomus plumosus*, known as the "Figure-of-8 worm," or "the blood-worm." It is common in our water-tanks, and every one must have noticed it at some time or other in their water-butts, probably making its way by a series of jerks, in which it alternately contracts its body into a double loop like the figure 8, and stretches it out straight. That there might be no doubt about this, I have kept a lot of them in very narrow vessels, thereby inducing them to make their tubes on the glass-sides of the bottle, so that their movements inside may be seen. I purpose writing a paper at some future time on the structure of these true tubes, which it is abundantly clear are not the work of our annelid *Tubifex*.

I could multiply almost indefinitely the account of our many contrivances in keeping *Tubifex*, but you will, I hope, conclude that I have given enough evidence to show you that it is not a tube-maker.

It may perhaps seem at first sight as if it were a matter of very little importance whether *Tubifex rivulorum* makes a tube or not. But to the physiologist studying worms it is of the greatest moment. A habit of tube-making is a certain step towards degeneration in an animal, and is accompanied by modifications in the organs of circulation and respiration of the very greatest importance to the comparative anatomist. The habits of every animal are so related to its structure that you may on consideration think it not so trivial a matter to acquire accurate knowledge even on so small a detail as the subject of my paper. I hope I may be allowed to follow it further in my own person at some future date.

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## MAY 7TH, 1885.

F. BUCHANAN WHITE, M.D., F.L.S., President, in the Chair.

Mr Robert Pullar, F.R.S.E., was appointed the Society's delegate to the forthcoming meeting of the British Association in Aberdeen.

### NEW MEMBERS.

The following were elected:—Mr R. Stewart Menzies of Hallyburton, and Mr Leslie Macdonald, teacher, St Ninian's, Perth.

### DONATIONS.

The following were intimated:—

*Perthshire Collection*. Grey hen—from Mrs Robertson, senior, of Struan; landrail—from Miss Scott, Kinclaven Crossing, Stanley; weasel—from Mr T. Marshall, Stanley; peregrine falcon and two fox cubs—from Sir Robert Menzies, Bart.; missel thrush—from Mr A. Steel, yr. of Blackpark; coal titmouse's eggs and nest—from Mr R. H. Meldrum, Cherrybank; magpie's nest and seven eggs, and missel thrush's nest and eggs—from Colonel Drummond Hay of Seggieden; common rat, and hedge-sparrow's nest and eggs—from Mr F. H. White, Annat Lodge; fishes—from Mr D. Henderson, Dundee; Perthshire plants—from Mr R. Kidson, Stirling; wood from neolithic canoe found at Friarton—from Mr Wood, Friarton.

*Library*. Five pamphlets from Mr H. Wilkie, Perth.

The following papers were read:—

1. "*Notes on a Supposed New British Willow.*" By F. Buchanan White, M.D., F.L.S.

The genus *Salix*, which includes the trees and shrubs familiarly known as willows, sallows, and osiers, is admitted by all botanists to present very great difficulties as regards the definition and limitation of the species contained in it. These difficulties arise not merely from the great variability of the species, but also because the plants naturally and not unfrequently produce hybrids or crosses, many of which have been at one time or other considered to be good species, while even yet there is a divided opinion about some of them. Such hybrids would not perhaps present such great difficulties if they partook of the char-

acters of both the parents in equal measure. But not only do they not do so, but as they are—though hybrids—quite capable of reproducing themselves, and being in their turn hybridised, we find secondary hybrids—*i.e.*, forms in which the characters of three species are combined—not unfrequently arising, and thus adding to the perplexities of the student.

That you may more clearly understand what is meant, let me briefly describe the structure and mode of fertilization of the flowers of a willow. The flowers, as you probably know, are massed together in spike-like masses called catkins, and the plants are what is termed "diœcious;" that is to say, only one kind of flower as regards the sex is found on an individual bush—one bush having pollen-producing flowers only, and another seed-producing flowers only. Rarely, and indeed as a monstrosity only, does the same catkin have both kinds of flowers. As for the fertilization, this is chiefly effected by the agency of insects. The flowers are odorous, and produce a greater or less quantity of nectar, which attracts insects of various species. These visit either kind of plant indifferently, and as the pollen readily adheres to them, they unconsciously convey it to the pistils of the seed-producing plants, and effect fertilization.

In the vast majority of cases the fertilization thus brought about is by the pollen of the same species as that of the fertilized plant, but it can readily be seen that in some cases the fertilizing pollen may be that of another species, and thus a hybrid be produced.

Why hybrids are not more frequent than they are may be due to several causes. Though many species of willows flower about the same time, yet there is often a little difference in the *exact* time, and thus the right pollen is brought to the right plant. Again, it is probable, though about this we are uncertain, that the pollen of one species does not so readily fertilize a different species as it does its own species, and hence the number of individuals of hybrids is limited.

I spoke a little while ago of hybrids in which the characters of three species were combined. To make my meaning clearer, I will express this in another way. If we take the letters A, B, C, &c., as standing for good and distinct species, the progeny of a cross between A and B may be expressed as A–B, and similarly between A and C as A–C. Now, keeping in mind that these, like their parents, are usually perfectly fertile, A–B or A–C may in their turn be crossed by D, the resulting progeny being A–B–D, or A–C–D as the case may be, which would be a form in which the characters of three species are combined. But instead of D entering into the composition of this secondary hybrid it may happen that it is one of the parent species, with the result that we get this formula, A–B–B or A–C–C. Continue this in succeeding generations, and the resulting plants recede in their characters more and more from A, and finally become almost undistinguishable from the good species which we have termed B or C. In this way it happens that we get plants which, though not quite agreeing in all respects with the essential characters of species, are very difficult to separate therefrom.

Another difficulty that the student of willows has to encounter is that, since the flowers of most species come out before the leaves, and as it is desirable for a right understanding of the species to have specimens of both flowers and leaves, and as it is essential that these should both come from the same individual bush, great care has to be taken in securing specimens.

From all this you will see that the willow-student has his work cut out for him, and it was with no little hesitation that for the purposes of the Flora of Perthshire I entered upon a study of the Perthshire willows. The work, however, had to be done by some one, and if I have learned nothing else, I have at least attained to an appreciation of the difficulty of the subject.

Though I do not purpose on this occasion to lay before you the result of my investigations—nor indeed are these sufficiently advanced for that—I may mention that it is evident that Perthshire is very rich in forms, and that I believe I have several which are new to Britain. But in the hope that more specimens of it may be looked for and found, I wish to say a few words about the specimens which I now exhibit. These I found some years ago on Maol Ghaordie, a mountain which lies between Glen Lyon and Glen Lochay. The exact place I do not remember, but it is not impossible that the same form may occur on other mountains in Breadalbane. In the absence of flowering specimens there must be a little doubt as to the correct determination of these specimens, but I am strongly inclined to think that they may be referred to *Salix spuria* (Schleicher) Willd., which Wimmer and other authorities on the genus consider to be a cross between *S. lapponum* and *S. arbuscula*.

That these specimens have much in common with these two species may be seen from the fact that having—before I commenced to study the willows—sent the specimens to Messrs Baker and Leefe, the two living British botanists who have made a special study of the genus, Mr Baker returned them as *S. lapponum*, and Mr Leefe as "*S. arbuscula ?* or a form of *S. phylicifolia.*"

At first sight the specimens are on the whole very suggestive of *S. lapponum*, but on examination they will be found not to agree altogether with that species, but to

depart from it in the direction of *S. arbuscula*. (I should say that both these species occur not very rarely on the Breadalbane mountains). The leaves of *S. lapponum* are variable, but one great character given by all authors is that the margin is entire or nearly so. An exception to this is Andersson, who, in his "Salices Lapponiæ," describes some forms as having serrulate margins. In the author's later work—in De Candolle's Prodromus—he, however, says the margin is quite entire or obscurely sinuate-serrulate, and points out that *S. spuria* is chiefly to be separated from *S. lapponum* by its more *serrated* and more glabrous leaves.

On the present occasion I do not propose giving a full description of our specimens, as it will perhaps be better to wait till I have had an opportunity of having them compared with authentic specimens. But I may point out that they may be distinguished from *S. lapponum* by the evidently glandular-serrate margin, upper surface more shining and finally almost or quite glabrous, under surface less hairy, their smaller average size, and perhaps by the shorter stalks somewhat less widened at the base. I think that also the texture of the leaves is harder and the pubescence of the young leaves more silky and less woolly. From *S. arbuscula* the greater and more persistent villosity, the less shining surface, and the browner colour when dried, readily distinguish our specimens. *S. spuria* has been recorded only from Switzerland and the Tyrol.

Whatever our specimens may prove to be, they are clearly separable from the ordinary form of *S. lapponum*.

2. "*The Native Timber Trees of Perthshire.*" By Mr W. Lindsay.

As the native trees of Perthshire form an important part of the botany of our county, and as a large portion of the Society's Museum is devoted to the illustration of these with specimens of the wood, leaves, flowers, fruits, seedlings, branches, and twigs, I have thought the subject not unworthy of the following remarks. So far as known, the following 19 species of trees are indigenous to Perthshire. Of the 80 orders into which the trees and shrubs of Britain are divided, 10 are represented in Perthshire.

Order *Aquifoliaceæ*, one species.

1. The Common Green Holly. (*Ilex Aquifolium*, L.)

The wood of the holly is almost as white as ivory, very hard, with a fine grain, and susceptible of a high degree of polish, and is readily stained with black, green, blue, or red. It is applied to a great many purposes in joinery, cabinet-making, turnery, engineering, and mathematical instrument-making, and is even used for wood-engraving. It is largely used as an ornamental tree and for hedges; and has this great advantage over deciduous trees and shrubs, that it is seldom liable to be attacked by insects. If kept closely clipped, the outer surface becomes impenetrable even to birds, who cannot build their nests in it. The name of the holly is probably a corruption of the word "holy," derived from its connection with Christmas-time. The German name Christdorn, the Danish name Christorn, and the Swedish name Christtorn, seem to justify this conjecture.

Order *Rosaceæ*, five species, belonging to three genera.

2. The Gean or Wild Cherry. (*Cerasus Avium* Mœnch.)

Found in hedge-rows and woods, and largely used as a stock for grafting the cultivated cherry on. The wood of the wild cherry is firm, close grained, and of a reddish colour. It is easily worked, and takes a fine polish. It is much sought after by cabinetmakers, turners, and musical instrument-makers. The fruit of this species is small, with very little flesh surrounding the nut, bitter before it comes to maturity, insipid when the fruit is ripe, and only fit as food for birds.

3. The Bird Cherry. (*Prunus Padus*, L.)

This tree or shrub, to attain a timber-like size, requires the shelter either of a favourable locality or of adjoining trees. In Britain the principal use of the bird cherry is as an ornamental tree, and few make a finer appearance than it does, either when in flower in April and May, or when covered with its racems of black fruit in August. It reaches greater dimensions as a timber tree in France, where it is much used by cabinetmakers and turners, who increase the beauty of its veining by sawing out the boards diagonally—that is obliquely across the trunk, instead of parallel with its length. The wood is hard and yellowish, and, in a green state, it has a disagreeable bitter odour and taste.

4. The Common Hawthorn (*Cratægus oxyacantha*, L.)

The common hawthorn in its wild state is a shrub or small tree, most commonly found as a large dense bush; but if systematically and regularly pruned it forms one of the most beautiful and durable trees, interesting for its sweet-scented flowers in May, and for its fruit in autumn. The wood of the hawthorn is very hard, and difficult to work; and its colour is white, with a yellowish tinge. It is not much used in the arts, because it is seldom found of sufficient size, and besides is apt to warp. By far the most important use of the hawthorn is as a hedge-plant. The name "quicks," which is not unfrequently applied to the hawthorn, means live, in opposition to hedges sometimes made of the dead branches of this plant.

5. The Crab or Wild Apple. (*Pyrus Malus*, L.)

Found in hedgerows and waste places. The wood of the crab is fine grained, hard, and of a brownish colour. It is principally used in this country for grafting the cultivated apple on. In France and Germany it is used for forming hedges, the branches of which are inarched into each other to give them more strength to resist cattle. Where the fruit abounds in quantity, it is given as food to pigs and cattle.

6. The Mountain Ash. (*Pyrus Aucuparia*, Gartn.)

Found almost in every part of Europe. Also called the fowler's service tree, or bird-catcher's service, from the use made of the berries by bird-catchers. The name Witchen, also applied to the mountain ash, bears relation to supposed powers of the tree as a protection against witches and evil spirits. The wood is fine-grained, hard, and capable of being stained any colour, and of taking a high polish. It is applied to various uses, when it can be obtained of adequate dimensions. The mountain ash will grow on any soil, and in any situation, being found on the seashore, and on the tops of mountains as high as 2500 feet.

Order *Caprifoliaceæ*, one species.

7. The Common Elder. (*Sambucus nigra*, L.)

Found plentifully in hedges, coppices, and woods. The elder is cultivated for its fruit, which is much in demand for making elder wine. The flowers and bark are much used by herbalists; and the wood of old trunks, being very hard, is used as a substitute for that of box and dogwood. The pith of the elder is used by electricians in various experiments.

Order *Oliaceæ*, one species.

8. The Common Ash. (*Fraxinus excelsior*, L.)

Some have supposed that the ash has derived its name from the colour of the bark of the trunk and branches. The timber of the ash is very elastic, so much so that a joist of this timber will bear more before it breaks than one of that of any other tree indigenous to Europe. The wood of young trees is more esteemed than that of old ones. Since the use of iron has become so general, the value of the ash is somewhat diminished; it still, however, ranks next in value to the oak, and is held even to surpass it for some purposes. It is much used by the coachmaker, the wheelwright, and the manufacturer of agricultural implements.

Order *Ulmaceæ*, one species.

9. The Scotch or Wych Elm. (*Ulmus montana*, Bach.)

The wood of this tree is in demand by the ship-builder, the boat-builder, the block-maker, the cartwright, the cabinet-maker, and the coach-maker. The wood is hard and capable of great endurance under water, hence it it is largely used for keels in shipbuilding. Its name is supposed to be derived from the Saxon word "Ulm." The city of Ulm is said to derive its name from the great number of elm trees that grow near it. There are above 40 places in England which take their names from the elm, such as Barn Elms, Nine Elms, &c.

Order *Salicaceæ*, three species, belonging to two genera.

10. The Brittle-Twigged or Crack Willow. (*Salix Fragilis*, L.)

Found naturally either in a cold soil and moist situation, or, if in a sandy soil, within reach of water. Willows are chiefly used for basket rods. This species, however, grows to dimensions which make its timber of some value.

11. The Grey Sallow, or Ash-coloured Willow. (*Salix cinerea*, L.)

This species is more of a shrub than a timber tree, found on the banks of rivers and in moist woods.

12. The Aspen Poplar. (*Populus tremula*, L.)

Some suppose that this tree derived its name from its being used in ancient times to decorate the public places of Rome, where it was called *arbor populi*, or the tree of the people; while others say that it alludes to the leaves, like the people, being easily agitated. It is found frequently in damp places. The wood is white and tender, and is employed by turners; by coopers for herring casks, milk pails, &c.; by sculptors and engravers; by joiners and cabinet-makers; and for various other purposes, such as clogs, buffers and brakes of railway carriages, butchers' trays, pack saddles, &c.

Order *Betulaceæ*, two species, belonging to two genera.

13. The Common Alder. (*Alnus glutinosa*, Gœrtn.)

Abundant on the margins of rivers and streams throughout the county. As its name indicates (*Alnus*, near the edge of a river), it thrives by the river. The wood, though soft, is of great durability. It is used for all the various purposes to which soft woods are generally applied —for turnery, sculpture, and cabinetmaking; for wooden vessels, such as basins, plates, and kneading troughs; for sabots, wooden soles to shoes and patens, clogs for women,

and similar purposes. Charcoal is largely made from the wood of the alder.

14. The Common Birch. (*Betula alba*, L.)

The name birch is derived from the Latin word *batuere*, to beat, the fasces of the Roman lictors being always made of birch rods. The birch is found in mountainous rocky situations, and growing wild in plains and peaty soils. There are only one or two other ligneous plants which approach so near the North Pole. The wood is white, shaded with red, and of medium durability in temperate climates, but lasting a long time when grown in the extreme north. It is largely used in turnery.

Order *Corylaceæ*, two species, belonging to two genera.

15. The Common or British Oak. (*Quercus pedunculata*, Willd.)

The oak, in point of usefulness to man, is only equalled by the pine. Loudon says :—"The latter may be considered the domestic, and the former the defensive tree of civilised society." The wood of the oak is, comparatively with that of other trees, hard, compact, heavy, tough, and durable ; and the entire plant, and more especially the bark, leaves, and fruit, abound in astringent matter and in tannin. It is unnecessary to mention the great use to which the wood of the oak is, or rather has in days gone by been, put. Although we no longer fight with "wooden walls," and the wood of this tree may not be so much in demand, yet the oak will still be looked upon as the monarch of the forest.

16. The Common Hazel (*Corylus Avellana*, L.)

Found in abundance on the banks of the Rivers Tay, Almond, and Ericht. The wood of the hazel is never found of a large size. The rods are chiefly used for making crates and walking-sticks.

Order *Taxaceæ*, one species.

17. The Common Yew. (*Taxus baccata*, L.)

Seldom found growing wild, but much grown as an ornamental plant in shrubberies, and for forming hedges, for which latter purpose, when kept clipped, it is well adapted. Being an evergreen of a sombre green colour, it is much used for planting in cemeteries and churchyards. The wood is hard, compact, of a fine close grain, flexible, elastic, and splitting readily, of a fine orange red, or deep brown colour. It is universally allowed to be the finest European wood for cabinet-making purposes.

Order *Coniferæ*, two species, belonging to two genera.

18. The Scotch Pine or Scotch Fir. (*Pinus sylvestris*, L.)

The Scotch pine is the most valuable, as regards its timber, of all the European species of Pinus. It will grow on almost every kind of soil, and at great elevations, as well as on plains. The varieties and variations of the Scotch pine are exceedingly numerous, both as to the general appearance of the tree, and the quality of its timber and resinous products. The wood on some light sandy soils is white, almost without resin, and of little duration; while on other soils, of a colder and more substantial nature, it is red, heavy, and of great durability. Places noted for producing timber of the latter quality are Rannoch, Strathspey, and Braemar. The facility with which the wood of the Scotch fir is worked occasions its employment largely in joinery and house carpentry. In point of durability, if it is kept dry, it equals the oak, more especially if it has been of slow growth, and is resinous.

19. The Common Juniper. (*Juniperus communis*, L.)

An evergreen shrub, found on hillsides and in sandy plains, also cultivated for ornament. The wood is more or less aromatic, and very durable, but never found of sufficient size to be of much use. In France, where the Swedish juniper has been found to grow 50 feet in height, tables, cabinets, and other pieces of furniture have been made from its timber.

The beauty of Scotland as a whole, and of Perthshire as part of it, is greatly due to the trees and shrubs that dot the landscape. The lively tints of the larch in spring and summer, the bunches of coral fruit of the rowan in autumn, and the bright red berries of the holly and sombre green of the pine in the depth of winter, all add to the charm of the landscape. Trees, however, are not only ornamental, but are necessary for the maintenance of the nation's health. To secure the best climatic conditions it is required that one-fifth of the total area of a country should be covered with forests. This is not so in these islands. With regard to the county of Perth, for instance, with an area of 1,600,000 acres, there are only 95,000 acres of woodlands. There is another urgent reason why tree-planting should be greatly extended, and that is that our timber-supply from abroad in a few years will be very much diminished, while nothing is being done to replace the natural forests of America, quickly disappearing before the lumber-man's axe. There is the greater need, then, that the waste and otherwise unprofitable lands in our own country should be planted. Perthshire could afford to plant 200,000 additional acres ; while

it is computed that in Scotland there are 5,000,000 acres of land only fit for tree-planting. It is satisfactory to know that the Legislature of the country is being importuned by competent parties with a view to have some compulsory measure introduced as to tree-planting. Whether any satisfactory results may follow or not, it is to be hoped that landed proprietors will see the necessity of increasing their plantations, and that much of what is now only a barren waste will soon be clothed with valuable timber trees.

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## SUMMER SESSION, 1885.

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The following Excursions were made :—

### May 21st.

1. *To Glen Tilt.*

By the kind permission of the Duke of Athole, the lower part of Glen Tilt was explored. The natural history of this picturesque glen is fairly well known as regards species which appear in the middle of summer (see various papers in *The Scottish Naturalist*), but the vernal animals and plants have been less perfectly investigated. A special object of the excursion was to ascertain if the Toothwort *(Lathræa squamaria)*, which grows in a few Perthshire localities whose physical features are similar to those of Glen Tilt, occurred there. The expectation was realised, numerous specimens being found in one spot. As is usual in Perthshire, the tree on whose roots the *Lathræa* was parasitic was the elm *(Ulmus montana)*. It is not improbable that the *Lathræa* occurs in more localities in Perthshire than is supposed, since, unless it is looked for early in the spring, it is difficult to detect it.

Amongst other plants observed were :—*Chrysosplenium alternifolium*, *Primula variabilis* (a hybrid between the Primrose and Cowslip, both of which occur), *Asplenium viride*, and *Encalypta streptocarpa*, with abundant capsules.

Altogether, about 119 species of flowering plants and ferns were noted.

In the zoological department, mollusca were the chief representatives, over a dozen species having been observed, including *Helix arbustorum*, varieties *alpestris*, and *flavescens*, and *Limax (Lehmannia) arborum.*

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### June 13th.

2. *To Ardoch.*

By the kind permission of Mr Drummond Moray, the proprietor, and Mr Bulloch, the tenant, of Ardoch House, the party was enabled to explore the policies of Ardoch House, the Roman Camps, and the banks of the Knaick. At the entrance lodge they were met by Mr Bulloch, to whose kind attention much of the success of the excursion was due.

Proceeding at once to the most perfect of the Roman Camps (the one which lies close behind Ardoch House, and which in the Ordnance Survey Map is called *Lindum)*, the members spent some time in examining the old earthworks. The camp has been so often described that it is unnecessary to give an account of its structure. Here some interesting plants were noticed. Some parts of the ramparts were covered with the pretty yellow flowers of the petty whin (*Genista anglica*), while in many places the short turf was bright with beds of the wild pansy (*Viola lutea*), with flowers ranging from every shade of purple to yellow and white, purple-hued blossoms predominating. Here and there little clusters of the curious moonwort fern (*Botrychium lunaria*) were seen. A little to the north of this camp is a small marsh, where, amidst the trailing stems of the cranberry (*Oxycoccos palustris*), with its lovely red flowers, and the white-topped tufts of a cotton grass (*Eriophorum vaginatum*), a rare sedge (*Carex irrigua*) was not uncommon. This was the best "find" of the day, as the plant has been found in Perthshire in three or four localities only.

A pleasant walk up the picturesque banks of the Knaick followed, and a number of plants, molluscs, &c., were observed, but none that call for special notice. Returning to Ardoch House, a short time was passed in inspecting the gardens, the condition of which reflects the greatest credit on the gardener, Mr Dingwall, who, we must not forget to mention, acted throughout the day as a most efficient and obliging guide to the party. In the gardens

the many rare and interesting plants in the herbaceous border were very attractive to many of the members.

After partaking of Mr Bulloch's kind hospitality, a visit was paid to a loch which lies within the grounds, but though a few more plants were noted, none of any great rarity were observed. In passing through a wood on the way to the Railway Station, the immense beds of a somewhat local plant, the wood stitchwort (*Stellaria nemorum*) were worth recording. During the day nearly 200 species of flowering plants were observed.

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### June 27th.

#### 3. *To Acharn and the Shores of Loch Tay.*

At Aberfeldy the party was joined by the Rev. J. M'Lean, of Grandtully, whose extensive knowledge of the district being freely placed at the service of his fellow-members, conduced greatly to the success of the excursion.

The first halt was made at the "Druidical" (so-called) circle of stones between Bolfracks and Kenmore. This circle, which is known as Croft Morag, is well worth inspection. On one of the prostrate stones, on the north-west side of the circle, are a number (about two dozen) of these mysterious sculptures termed "cups," some of them being also surrounded by rings. "Cup and ring stones" are not uncommon in this district, but the one mentioned is amongst the best examples.

The next halt was made at Remony, for the purpose of inspecting the collection of the rarer birds and quadrupeds of the Loch Tay district made by Mr Duncan Dewar, an Associate of the Society. Unfortunately, Mr Dewar was absent on business in England, but the collection was kindly shown to the party by Mrs Dewar. Amongst the quadrupeds the most interesting were two specimens of the wild cat,—one killed at Finlarig many years ago, but the other obtained near Remony during the past spring. The occurrence of this latter specimen is especially interesting, as it serves to show that the wild cat is not altogether extinct in Perthshire. Amongst the more remarkable birds in the collection may be mentioned the osprey, red-throated grebe, black guillemot, razor-bill, gannet, Leach's petrel, and waxwing, all obtained in the district. Of other local curiosities attention was particularly directed to a flint arrow-head found by Mr Dewar on one of the neighbouring hills; and also to a shell of the snail *Helix aspersa* found in the neighbourhood. This species is usually confined to the vicinity of the sea in this latitude, and though it occurs in one or two places near Perth, is of very rare occurrence inland. In the Loch Tay district it has possibly been purposely or accidentally introduced.

Leaving Remony, the party proceeded to commence field-work, which was almost entirely restricted to the department of botany. Near Remony a considerable number of specimens of one of the wood-rushes, *Luzula albida*, were observed. This plant is not admitted into the British lists, but it has now been found in about half-a-dozen localities in Perthshire, and it is difficult to account for its occurrence, as it has no qualities which would lead to its intentional introduction. At the same time it is probable that it has been introduced. Amongst other plants found at Remony were *Galium erectum* and *Tragopogon pratensis*, the latter doubtless accidentally introduced, as, though it occurs rarely in the neighbourhood of Perth, it is apparently not native further inland.

It was expected that the ravine below and above the Falls of Acharn would have been rich ground for botanising, but such did not prove to be the case. The only rare plant found was the wood fescue grass (*Festuca sylvatica*), which is by no means common in Perthshire. However, if the botany was poor the scenery made up for it, and a very pleasant hour was spent in the glen. Descending the burn, the shores of Loch Tay were reached, and here a much more productive field for work was found. Unfortunately, the time was too short to admit of a thorough exploration of the shore between Acharn and Kenmore, but it seems well worthy of investigation. The most noticeable plant was the globe flower (*Trollius Europæus*), which grows there in greater profusion than we have seen elsewhere. The golden ball-shaped flowers, each supported on a tall stem, shone forth to great advantage above the vivid green of the grass and other herbage. Of other plants observed the more noteworthy were *Subularia aquatica*, *Cardamine amara*, *Thalictrum majus*, and *Carex vesicaria*. During the day about 190 species of flowering plants and ferns were noted.

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### July 18th.

#### 4. *To Stuc a Chroin, one of the Peaks of Ben Voirlich.*

This was the only mountain excursion that had been fixed for the season, and though the weather was not all that could be desired, the excursion was both successful and pleasant. Taking train to Lochearnhead

Station, the party proceeded to Edinample, and thence ascended Glen Ample for some miles till the glen between Ben Voirlich and Stuc a Chròin was reached. Up to this point neither the fauna nor the flora had presented any special features of a mountain character, though one or two good plants had been picked up. These included *Galium erectum*, *Vaccinium oxycoccos* (the cranberry), *Scirpus pauciflorus*, and *Carex pauciflora*, all of which occurred near Lochearnhead.

Leaving Glen Ample, one of the spurs of Stuc a Chròin was ascended, and when an altitude of about 1500 feet had been reached the alpine flora began to appear in considerable abundance. As the ascent was continued, plants new to many members of the party were constantly met with, and from their beauty or comparative rarity elicited many expressions of admiration. The most beautiful of all was the Mossy Campion, an alpine plant which grows in dense cushions, often a foot or more in diameter, and of a dark green colour, over which the rosy-red blossoms are thickly scattered.

Hitherto the day had been comparatively fine, but now the mist descended on the party, completely shutting out any view of the hill that was being ascended. Still upwards the enthusiasts press, till at last the top of the peak is apparently reached, but when the aneroids are consulted it is found that they are yet 800 feet below the summit. A slight descent is made till an ascending saddleback —a steep slope on one side and a yawning gulf enveloped in mist on the other—is found, and up this, climbing painfully from one rock to another, the mountaineers proceed, and at length stand on the summit of Stuc a Chròin. Here, amidst the driving mist and pelting rain, a meeting of the Mountain Club was held, at the exact hour for which summonses had been issued. In the absence of the Cairnmaster, the cairn was occupied by the Scribe and Annalist, and the Geometer having declared the altitude of the hill to be 3189 feet above sea-level, a number of new members were initiated, the Quaighbearer being in attendance with the quaigh. After the toasts peculiar to the Club had been duly celebrated, and other business transacted, the members proceeded to investigate the botany of the peak so far as the mist permitted. A precipice, the extent and depth of which could not be seen, bounds two sides of the summit, and was examined as far as practicable, the result being that several rarities were detected, sufficient to indicate that under more favourable circumstances much more might have been found. The best plant seen here was *Saxifraga nivalis*, the discovery of which added a new "vice-county" to the record of its distribution in Britain.

The descent was now begun on the opposite side from which the ascent was made, and some likely-looking rocks having been found, some time was spent in examining them with good results—a hawk-weed, probably *Hieracium holosericeum*, being the most notable find, and a very good one. Near the same spot, in marshy ground, *Juncus biglumis*, another great rarity, was also detected. After a short inspection of Lochan a Chròin —a small lakelet that lies in the bosom of the mountain, and which produced nothing remarkable—a return was made to Glen Ample. In Glen Ample the party divided—some electing to go back to Lochearnhead Station, others to cross the ridge that separates Glen Ample from Strathyre, and the rest to go to the head of Glen Ample and descend on Loch Lubnaig. Most of the members met again at Strathyre Station.

In addition to the plants already mentioned, about 150 flowering plants and ferns were noted during the day. Insects were scarce, but the rare *Scoparia alpina* was captured. Amongst molluscs the only species observed was the common black slug (*Arion ater*). Of birds almost the only species seen were red grouse, black grouse, ptarmigan, and ring-ouzels; and of mammals, red deer, mountain hares, and rabbits. Frogs were as usual common at a high altitude, and in Lochan a Chròin tadpoles were seen.

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JULY 25TH.

5. *To West Bank of Tay, from Grandtully to Dalguise.*

As the flora of the banks of the River Tay is one of the richest in Perthshire, it has always been considered desirable that one or more of the season's excursions should each year be made to some part of the course of the river. The whole length, from Loch Tay downwards, has now in this manner been investigated, but the portion between Grandtully Station and Logierait had not previously been visited by the Society. The right bank only of the river was traversed on this occasion, and the flora found on the whole pretty similar to what it is in the other parts of the upper course of the Tay. The most notable plant observed was one of the sedges, *Carex aquatilis*, which has not hitherto been recorded from this part of the county.

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### AUGUST 8TH.

6. *To the Linn of Campsie.*

THE neighbourhood of the Linn of Campsie is not only a good field for the botanist, but presents some interesting geological features. As is well known, the Linn is formed by a large trap "dyke," which here stretches across the Tay. From the low condition of the river, the party was able to examine much more of the dyke than usual, and to investigate several curious "pot-holes" that are usually covered with water. "Pot-holes," it may be explained, are circular excavations in the solid rock, and are formed by the current revolving a hard stone or stones in them. Occasionally they are of great size and depth. Another point of geological interest to be seen at the Linn (but better near a smaller dyke a few yards south of it) is the alteration in the Old Red Sandstone rock caused by the heat of the molten rock that pierced it to form the "dyke." In some places the sandstone is quite friable in consequence; in others it has been rendered harder than usual. Leaving the geology, attention was directed to the botany of the locality, and a number of interesting plants found and examined. Amongst these were *Veronica anagallis*, *Potentilla procumbens*, *Alchemilla alpina*, and others.

Leaving the Linn, the party next crossed the river, and descended the east bank. The most interesting plant found here was one of the Bell-flowers, *Campanula glomerata*, which only one of the party had seen (as a wild plant) in Perthshire before. Don, the well-known early investigator of Scottish botany, records the plant as from "near the Linn of Campsie," as long ago as 1806; and the Rev. Mr Liston mentions it as growing on the banks of the Tay in Redgorton parish in 1837: but since that time it has been either overlooked or passed by as an introduced plant. It, however, has all the appearance of being truly native, and as such we accept it. It occurs along the banks for several miles.

Near the "Cat Hole" another rare Perthshire plant was found—the Hemp Agrimony (*Eupatorium cannabinum*). Passing on to that wild part of the river which rejoices in the euphonious and very appropriate name of "Hell's Hole," the margin of the water had to be left and the rocks ascended. Hence, looking down on the black abyss below, Virgil's "Facilis descensus Averni" readily suggested itself to the classical mind of the beholder. Near this, several specimens of the rare and curious bird's-nest orchid (*Neottia nidus avis*), were found. This plant is of a pale brown all over and has no true leaves, deriving its sustenance from the decaying vegetable matter amongst which it grows. After passing the ruins of Cambusmichael Church some of the party crossed the river and returned to Stanley, while the rest followed the Tay down to Perth and added several other interesting plants to their collection.

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### AUGUST 22ND.

7. *To North Bank of Earn, from Forteviot downwards.*

STARTING from Forteviot Station, the party explored (by the kind permission of Lord Kinnoull) the north bank of the Earn, and adjacent "back-waters," nearly as far as Forgandenny. After that point the river was left, and the hill road to Perth taken.

Amongst the more interesting plants observed may be mentioned that curious orchid, the broad-leaved helleborine (*Epipactis latifolia*); the pretty red-flowered *Erythræa centuarium*, a plant very local in Parthshire; the yellow-flowered *Limuanthemum nymphæoides; Carex paludosa* and *C. remota;* and a number of curious willows. The zoologists of the party had nothing remarkable to report.

# PROCEEDINGS

OF THE

# Perthshire Society of Natural Science.

VOLUME I. PART VI.

1885–86.



PERTH:
PUBLISHED BY THE SOCIETY
AT THE PERTHSHIRE NATURAL HISTORY MUSEUM.

MDCCCLXXXVI.

# SESSION 1885-86.

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November 12th, 1885.

Dr. F. Buchanan White, F.L.S., President, in the Chair.

NEW MEMBERS.

The following were nominated :—

Mr C. T. C. Grant of Kilgraston ; Mr A. Shields, Summerbank ; Mr Grimmond, Oakbank, Blairgowrie ; the Rev. Robert Kemp, Blairgowrie ; Mr G. Smith, Law Park, Blairgowrie; Mr A. Williamson Davidson, Edinburgh; Mrs Tait, St Madoes; and Mr Macduff of Bonhard.

Mr J. Brebner, F.L.S., Dundee, was recommended by the Council as a Corresponding Member.

DONATIONS.

The following were intimated :—

*I. Perthshire Collection.*—Birds' nests and eggs—from Mr W. Duncan, Almondbank; Mr R. H. Meldrum, Cherrybank; Col. Drummond Hay, and Master F. H. White, Annat Lodge; allis shad—from Mr Pitcaithly; two weasels —from Mr G. M'Gregor, Moncreiffe ; rat—from Mr J. Dow, Gask; two stock doves—from Mr Lee of Blairhoyle; mole—from Miss M'Kenzie, Balhousie Street ; wood warbler—from Mr Wood of Freeland ; water vole—from Sir R. Menzies, Bart. ; squirrel—from Mr W. Duncan, Almondbank ; minerals—from Dr Buchanan White, and from Mr Donald Cameron, Paisley ; plants—from Dr White, Mr J. Coates, Mr A. Sturrock, Rattray; Mr J. Brebner, Dundee ; Mr C. M'Intosh, Inver ; Mr J. M'Bryde, Dunkeld; and Mr S. Grieve, Edinburgh. Tree pipit's nest and eggs—from Mr G. Alexander ; insects—from Mr T. M'Gregor, Tay Street.

*II. Index Collection.* — Abnormal pheasant chicken — from Mr C. A. Murray, Taymount ; algæ—from Mr Simson, Dundee.

*III. Library.*—Backhouse's "Monograph of British Hieracia," from Mr Barclay, Craigie School, and "Report on Geographical Education," from Mr Robert Pullar.

EXHIBITIONS.

Dr Buchanan White exhibited the following :—

1. A curious alga or water-weed, that had been sent to him to name by Mr W. B. Simson, of Dundee, who afterwards kindly presented the specimens to the Index Collection. These specimens, which resemble balls of green velvet, and are several inches in diameter, were found in Kildonan Loch, South Uist, and the anglers who visit the loch were much puzzled as to their nature and origin. The balls lie loose amongst the stones at the bottom of the loch. On making a section, they are found to be hollow, but with a loose nucleus of earth, the walls being composed of matted filaments of the alga. The plant is *Cladophora ægagropila;* rather a rare one, but found in North England and Wales, as well as in Scotland. The origin of the balls is probably as follows. One of the zoogonidia (as the special form of spores in this group of algæ is called) having germinated, the filaments radiate from it in every direction. As the plant increases in size, the external filaments become matted together, along with grains of sand, &c. As growth goes on, the centre from which the growth of the plant originally started decays, and a hollow ball is formed, which is always increasing in size at the periphery by the growth of the filaments, while at the same time the internal hollow becomes larger by the decay of their internal ends. The decaying filaments, and the earth that was entangled by them when growing, make up the loose nucleus. I am not aware whether this nucleus occurs in living specimens. It may perhaps be formed after the plant has been removed from the water.

2. An apple. In view of the papers "On the Cultivation of Fruit Trees on Waste Ground," by Dr Robertson, of Errol, with which we were favoured some time ago, this apple is interesting as forming an instructive commentary on the plan of cultivation urged by Dr Robertson. The apple was sent to me by Colonel Drummond Hay, and its history is as follows. A year or two ago an apple tree sprung up on the side of the railway bank at Seggieden. Whence or how it came there is unknown, but probably it sprang from a chance seed. Last year it bore a few apples, but their quality was not tested. This

year it was laden with beautiful apples (many larger than the one shown), which proved to be of very good quality as "eating apples." Since the tree owes nothing to the care of the cultivator, having been neither grafted, pruned, nor manured, it affords a strong argument in favour of Dr Robertson's plan of utilising waste ground by planting fruit trees thereon, though Dr Robertson did not, I think, urge that the care of the trees should be left to nature, but rather the reverse.

3. Some specimens of nature-printed portraits of moths.

### OPENING ADDRESS BY THE PRESIDENT.

Dr Buchanan White delivered the following address:—

It has never been a regular custom in this Society to open the winter session by a Presidential Address, and if I do so on this occasion, it is of course within the discretion of my successors in office whether they continue the practice or not. At the same time a good deal may be said in favour of so beginning the session. The work done during the by-gone summer can be passed under review, and the work to be performed during the coming winter can be discussed; while attention can be called to many little things which it is desirable, for the welfare of the Society, to bring under the notice of members.

To begin with the work of the past summer session. The programme of excursions that was arranged in spring was carried out with great success, and if our trips were not attended by so many members as might have been wished, the explorations were not the less successful. In addition to the excursions on the programme, several others were made by some of the members, and as no account of these appears in the "Proceedings," it is desirable that a record should be made of some of the discoveries that have resulted therefrom. These are for the most part in the department of botany, and in alluding to them, I have also to notice some other remarkable Perthshire plants recently found. To our friend, Mr Brebner, of Dundee (lately an "Ordinary Member" of the Society, and now nominated as a "Corresponding Member"), must be ascribed the honour of having made the most note-worthy 'finds." Mr Brebner has for the last two or three summers spent part of his holidays in Perthshire, and, being aware of our desire to accumulate knowledge regarding the distribution of plants in the county, has kindly devoted part of his leisure to the exploration of the districts in which he has been residing. In this way he has been eminently successful in adding to our knowledge, and the Society is very greatly indebted to him for many valuable and interesting specimens. The most remarkable of his discoveries are the following four species, examples of which I now exhibit:—

1. *Schœnus ferrugineus*, L.—This sedge is new not only to Perthshire, but to the British Flora. It is rather locally abundant in Strathtummel, where, in company with Mr Brebner, I had the pleasure of gathering it last July. Though I include it in the list of the past summer's plants, it was first found by Mr Brebner in 1884.

2. *Carex ustulata*, Wahl.—This is another sedge, and though not new to Perthshire, is of very peculiar interest on account of its history. It was first discovered, as a British plant, on Ben Lawers, by Don, in August, 1810 (through the kind generosity of Mr John Knox, of Forfar, our herbarium possesses one of Don's original specimens). Since that time no one seems to have succeeded in finding it in Britain, and hence it has been relegated to the list of Don's "reputed discoveries." It is true that in the *Yorkshire Naturalist* there was a statement not long ago that the plant had been, within comparatively recent years, gathered on Ben Lawers, but as this statement was not authenticated by the name of the writer, it must bear the fate of all such anonymous records. Mr Brebner's specimens were gathered on Ben Heasgarnich, near the head of Glen Lyon. It is worthy of note that Mr Brebner remarks that when growing, *Carex ustulata* much resembles *C. atrata*, an alpine sedge which is not uncommon on some of our hills. Hence it might be liable to be passed over.

3. *Polypodium flexile*, Moore.—This pretty little fern was first discovered in Glen Prosen, in the neighbouring county of Forfar; but in this locality it has long been reported as extinct, having been eradicated by the rapacity of amateur or professional fern-collectors. *

* *Apropos* of this eradication, I should like to ask the attention of the Society to the very serious fact that many of our ferns and other plants are being fast exterminated, or at least made very rare. In a few cases botanists may be to blame for this, though I hope not. More frequently the extermination is due to the indiscriminate ravages of the amateur fern-collector. But most of the mischief is done by certain persons who collect ferns, &c., for sale to the summer visitors. Most of the specimens thus collected and sold will never grow, which, as punishing those concerned in it, is a little consolation; but in the meantime our hills and woods are being robbed of their choicest treasures. I might give several examples of some of our plants which from this cause have become very rare, as, for instance, *Lathyrus niger* at Killiecrankie, *Pyrola uniflora* at Scone, &c. I do not know whether the Society can take any effectual steps for the preservation of the rarer native plants, but I think it is a subject that it would do well to consider. In some cases good might be done by calling the attention of the proprietors of the ground to the evil that is being done.

It was afterwards discovered on Ben Aulder, which, though not in Perthshire, is yet in the area of the Tay basin, and hence within the district of our flora. But during the past summer Mr Brebner found it in Glen Lyon, and so we can claim it as a Perthshire plant. Many authors consider *Polypodium flexile* to be merely a variety of the common *Polypodium alpestre*, but in a paper that I read to this Society some years ago, I contended for its specific distinctness, and to that opinion I still adhere.

4. *Astragalus alpinus*, L.—A pretty little vetch, with white and purple flowers. This is not uncommon, though very local, on a hill in East Perthshire. I do not mention the locality, fearing for the plant the fate which, as I have mentioned, has befallen some of our rarer species whose localities lie in the tourist-trodden parts of the county. The original finder of this vetch in Perthshire was my friend, Mr P. Neill Fraser, of Edinburgh, but as he did not get the plant in flower, there was some degree of uncertainty about its identity till Mr Brebner gathered it in blossom. Its only other localities in Britain are the original one in Forfarshire (where it seems not to have been found in recent years) and the other in Aberdeenshire, where I believe it is still common. In its Perthshire locality it grows in company with another rare vetch, the *Oxytropis Uralensis.*

Passing on to the discoveries of some other botanists, I will first notice the finding of a new locality for the rare *Cynoglossum montanum.* So far as Scotland is concerned, this plant has been found (so far as I know) only in Perthshire, and as it is not known further north in England than about the middle of that country, it has been the custom to consider it as merely a naturalised plant in Scotland, This is due, I suppose, to the fact of the long interval between the localities where it is native and the Perthshire ones, and also because it is not a North European plant. But as there are instances of a much greater space between localities where a plant is certainly indigenous, I do not see any good reason for doubting the indigenous character of *Cynoglossum montanum* in Perthshire. I am not aware that the plant itself possesses any qualities for which it would be cultivated, whether for its uses or its beauty, for it has neither. In Perthshire it was first found by Don about 1820 at Fingask, where it is still common. It is also abundant in a thicket at Barnhill; and this summer Mr R. H. Meldrum discovered it on the other side of Perth, near Cherrybank, where it grows among brushwood in an old quarry, along with, among other plants, *Pyrola minor.* On the whole, I am inclined to consider it as truly indigenous in Perthshire. We have not hitherto had a botanist residing in the vicinity of Cherrybank, and, moreover, that district does not look as if it would be very productive. It is therefore very interesting to find that the *Cynoglossum*, though the chief, is not the only discovery made by Mr Meldrum, who has found several other local plants between Cherrybank and the Earn, as, for example, the pretty *Erythræa centaurium*, *Carex remota*, *Ranunculus arvensis*, &c.

*Campanula glomerata* is another interesting plant whose occurrence in Perthshire has been verified during the past summer. As a Perthshire plant, it was recorded so long ago as the beginning of the century by Don, who, in one of his "Fasciculi," says that it grows near the Linn of Campsie. At a later date, the late Rev. Mr Liston recorded it from the banks of the Tay in Redgorton parish; and I have a vague recollection of some more recent record of it from the banks of the Tay above Perth. Be that as it may, the species had become, so far as Perthshire is concerned, merely a memory, till Mr Barclay informed me that he had seen it in some abundance on the east bank of the Tay not very far below the Linn of Campsie. Guided by him, we, at one of our excursions, visited the place and found the plant, tracing it down the river for several miles. I think also that Mr Barclay subsequently informed me that he had found it on the Woody Island. The question arises, is *Campanula glomerata* native in its Perthshire locality? It is undoubtedly native further north (and further south) in Britain, but in the north it seems to be confined to the sea coast of the East of Scotland. On the banks of the Tay it has all the appearance of a wild plant, and as such I am inclined to consider it, though it must be kept in mind that many plants on the banks of the Tay are merely naturalised.

I might extend this list of plants, that have been found during the past summer, very considerably, but will mention only one or two others.

*Carex lævigata*, for which we had only two records in Perthshire, I found when making an exploration with Messrs Barclay and Meldrum, on the banks of the Earn below Crieff. On the same day we found *Arabis perfoliata* on the walls of Innerpeffray Castle. Whether the latter is native or not in Perthshire, I will not at present discuss. In company with the same gentlemen, I found *Mentha rotundifolia* on the banks of the Almond near Lynedoch. This rare plant is probably only an escape, but its occurrence is decidedly worth noticing.

Before leaving the department of botany, I should say that a great deal of material for the elucidation of these very difficult groups, the Brambles and the Willows, has been collected during the past summer by Mr Sturrock, of Rattray; Mr C. M'Intosh, of Inver, and myself; and that

the result will be a great addition to our knowledge, when the plants have been worked out. In the other departments of natural history I do not think so much has been done as amongst the plants, though of course the workers in these divisions have not been idle. In connection with these, I should like to take this opportunity of saying that if the members of the Society and others to whom lists of the Perthshire mammals were sent (in order that the species occurring in the different parts of the county might be ascertained) would now return the lists to me, I should be much obliged. When the lists have been returned, I will hope to be able to bring the results of my investigations before the Society.

We have now to briefly consider the work before us during the coming winter. From the syllabus of papers to be read, it will be seen that a fair proportion of them relate to the natural history of Perthshire. This is as it should be, for the special work of a local Society is the elucidation of the natural history of its own district; and if it does not take up that, it is not doing its duty, and might as well cease to exist. At the same time it is desirable that papers of a wider scope—always provided that they be original, and not merely a *resumé* of what is or ought to be already known to every student of nature—should be intermingled with the others, and this is what our syllabus presents.

I do not purpose noticing in detail the papers in our programme, but there is one to which, as it presents some novelty, I wish briefly to allude. This is the paper, or series of papers, on the natural history of Kinnoull Hill. The plan adopted for these is new, so far as our Society is concerned. If the result prove interesting and instructive, as I think it should, the plan might be extended to other places in our district, and their natural history discussed in a like co-operative manner. I mention this now in order that, if taken up, the members concerned may begin to collect material for working it out.

It will be seen from the programme that we purpose having this session another couversazione. Your Council had under consideration several proposals for a conversazione on a rather more extensive scale than the one of last winter session, but after deliberation it was not considered advisable to go beyond our own building, nor to depart from the lines of our very successful gathering last January.

Hitherto, I have been treating of the work that may be done at our ordinary meetings, but there is other work that may be performed by members who are desirous of helping the Society. As you are aware, we have now a very large collection of Perthshire plants, but till these are properly fixed down to sheets of paper they cannot be available for examination by members. Hitherto the labour of doing this has fallen upon one member, Mr James Coates, who has also other duties in connection with the work of the Society; but, owing to the rate at which our specimens have accumulated, it is quite beyond the power of one person to overtake the work. We would therefore ask members to volunteer assistance in this matter. All material will be provided, and instructions given.

Another department in which members can assist is the Perthshire Geological Collection. This part of the Museum is by no means so far advanced as it ought to be. What we need are specimens illustrative of the rocks of all parts of the county, and though a little knowledge of geology would greatly assist the collector, yet specimens may be collected without such knowledge. One thing is necessary, and that is that each specimen should have the name of the locality carefully attached to it, and mention made as to whether it is from the living rock, or from a detached boulder. Especial attention should be directed to the boulder clay wherever sections of it are exposed, and all the kinds of stones in it collected, labelled with locality, and sent to the Museum. This is work that might be done by any member, and such specimens would be very valuable for the Museum.

In conclusion, I have a word or two to say about the Museum. During the past summer there has been a large number of visitors to it. Some of these have been naturalists well qualified to criticise, and I am glad to say that in every case within my knowledge the criticism has been very favourable. I am tempted to give you the opinions expressed by two very well-known men of science. Professor Flower, who is the Director of the Natural History Department of the British Museum, and who, therefore, it must be allowed, is well qualified to offer an opinion on Museums, spent more than two hours with Colonel Drummond Hay in our Museum, and made a most minute examination of it. Remarking that one of the very best methods of conveying instruction in Natural History was by local references, he said that he considered our Museum to be one of the best arranged local ones he had seen. An Index Collection was essential, and ours, so far as it went, was admirably arranged for the purpose. (You will remember that in my annual address last March, I pointed out the necessity of giving, when we have the means, more space to the Index Collection.) The collection of Perthshire Lepidoptera was also an object of special notice, Professor Flower expressing the wish that they had in the British Museum as good a collection—in proportion—of British Lepidoptera.

He was also much pleased with all the other departments. In a subsequent letter to Colonel Drummond Hay, Professor Flower expresses the hope that we will be able to continue and extend the Museum on the same lines as we have begun. The other naturalist to whom I referred is the well-known ornithologist and explorer of the natural history of Palestine, Canon Tristram, of Durham. He spent a whole afternoon in the Museum with our Curator, and his opinion is as follows:—"Though small, it is my *beau-ideal* of what a local museum should be; and by no other arrangement could you so interest and instruct visitors who wish to learn something of the local fauna and flora." The collection of nests—crushed together as they are from want of space—was much admired by Canon Tristram, who in fact had not a single unfavourable criticism to make in any department.

I may add that, as imitation is said to be the sincerest flattery, Professor Trail is paying a great compliment to our Museum by getting up one on the same lines in Aberdeen.

With these commendations (and many others might be added) of the result of our labours, we ought to be encouraged to endeavour to continue the good work. It is, unfortunately, the case that the limited funds that we had at our disposal have now been exhausted. and we cannot, perhaps, entertain very sanguine hopes of raising more just at present. But what has been done in the past may be done again in the future; and, therefore, I think we should constantly keep in mind the necessity of not only maintaining, but of extending, the Museum. Retaining this always—in season and out of season—in view, we cannot fail to be succeseful in reaching our goal.

The following paper was read:—

"*The Fossil Diatoms of the Tay Basin.*" By Dr Trotter.

It is not my intention to-night so much to treat of the diatoms of the Tay, as to supplement my former paper with some account of the alluvial beds of the Perth Basin, and of the various microscopic objects—chiefly diatoms—found in them. The Perth Basin, as you are all aware, is a deep depression, near the south-eastern extremity of the great band of the Old Red Sandstone, stretching from S.W. to N.E., and forming in our own neighbourhood the well-known Howe of Strathmore. The deepest part is where the Tay passes out of it on the S.E. between the lofty basaltic rocks of Kinnoull Hill and Moncreiffe Hill. It gradually shoals towards the Almond, and is closed on the north by the high land in the neighbourhood of Luncarty. Along part of its western side an ancient shore is still very distinctly visible in several places (the sand-hills forming its margin being in some places extensively excavated for building purposes), and is very conspicuous near the residence of the late Sheriff Barclay at Craigie, at the Craigie Public School, and at Wellshill on the west, and at Comely Bank on the east.

It becomes an interesting question whether this basin was originally an inland lake, which had gradually worn a way through the hard rocks of the Sidlaws, and emptied its waters into the estuary beyond, either by the opening out of a chasm at the same place, or by the gradual wearing of glacier ice, the action of which has left unmistakable impressions on all the rock surfaces around; or whether it was simply a land-locked arm of the sea, which gradually became silted up by the deposition of alluvial mud from the River Tay. If the latter, it becomes necessary to consider whether the clay of this basin could have been deposited in an arm of our present sea, or whether it is imperative to conclude that when the deposition occurred, the land was at a lower level than at present.

At the Friarton Hole, just below the harbour, there are exposed a number of strata of a red clay, very soft and plastic, and of unknown depth, with the appearance of having become almost rock. This clay appears in various places in the basin, sometimes red sometimes yellow, but bearing similar characters everywhere, and always seeming to be the basis on which the other deposits rest. It is very finely seen in a deep pool at the lower end of what is called the "Woody Island," nearly opposite Scone Palace. I have repeatedly examined portions of this clay from various places, but in no case have I detected any organism in it. It is as barren of organic remains as a piece of granite, and gives a different series of colours with the polariscope, appearing to consist in great part of silicate of alumina.

It is difficult to conceive of any body of still water existing long enough to deposit repeated layers of fine mud over such a large extent of bottom, without the presence of even the simplest organisms; but careful investigation has so far failed to reveal anything of the kind. Lying immediately above this, however, is a clay, almost similar in general appearance, though of a bluish colour; but under the microscope its appearance is very different, for it is full of pieces of silica of various sizes, and in addition contains numerous organic remains.

The commonest of these are what are believed to be sponge spicules. *Spongiolithis acicularis* is very plentiful, a piece of clay twice the size of a pin's head—a size suitable for examination—containing on an average twelve entire specimens, besides numerous broken fragments. These organisms, which look like the sharp halves of two needles joined together at an angle of from 5 deg. to 10 deg., are composed of silica, with a tubular cavity extending through the whole length, and opening with an oval aperture almost at the end. They show no markings of any kind, even with the highest powers. Some authorities consider them to be Diatoms, while others think them Sponge Spicules. They are not uncommon among the live diatoms of the Tay, and appear to move about like the others, but I have failed to colour them with any of the stains which colour the diatoms. At the waterfall at Craighall, one of the commonest diatoms, about which there is no doubt, exactly resembles these, except that there is a small protuberance in the angle, and it is about the size of the smallest of the spicules. Whether sponge spicules

or not, they are found in the clays of fresh, brackish, and salt waters alike, in the mud of the River Amazon 1200 miles from the sea, and in the sand at the bottom of the Indian Ocean, and in some alluvial clays they are the only organisms that occur. The spicules of a considerable number of sponges, however, are of exactly similar appearance.

An undoubted sponge spicule, however, is also found in this lowest clay, but is much scarcer. It somewhat resembles one-half of the other, but is more slender and less tapered, with a smaller portion furnished with a head attached at an angle of about 5 deg., this smaller piece having usually a few little protuberances on it. It looks very like a pin, slightly bent about 1-6th of its length from the head, and is hollow.

A very pretty diatom, but one which is very awkward to mount, occurs in this bed of clay, *Campylodiscus Clypeus*, of which I have been unable, from want of proper cells, to preserve a perfect specimen, the cover-glass breaking them in a day or two by its weight. This diatom is an oval plate of silica bent till the outline of its edge forms a semi-circle, and when seen in front looks like a circle with a portion cut off.

Another rather common diatom in this clay is a little round brown-coloured one, of which there are two varieties, the one having a round hole in the middle, and the other having none. They appear to be the upper and lower halves of a little circular box, each half being about one-third of a globe. I have not been able to ascertain the name, but they are found in recent clays also. They show no markings, with the exception of a ring round the edge (seen with a 1-14th objective), though the brown colour points to the existence of such.

A very pretty little diatom, apparently a *Surirella*, is very common, but is difficult to pick out, it is so thin and fragile. It is navicular or boat-shaped, but has no central raphe or nodule. It is a thin transparent plate, without any central markings, but with a row of little ridges, one-fourth of its diameter in length, forming a sort of border round the edge.

All these are brackish-water diatoms, but among them turns up a very familiar fresh-water diatom, *Gomphonema geminatum*, differing from the ordinary forms of the Tay by being broader and shorter. This is one of the finest but commonest of all. This diatom has a habit of turning up in all sorts of unexpected places, and last summer I found it in some salt-water mud near the Mull of Galloway, the nearest fresh-water being over a mile off.

It would appear from the above that this clay was deposited from brackish water, but whether the organic remains were once alive where found, or whether they were carried down by the stream from a higher source, it is impossible to tell.

Above this blue clay lies a bed of sand about 10 feet thick, in which I found no diatoms, and above that a thin bed of clay with remains of vegetable substances intermixed. In this various forms of *Pleurosigma* were very numerous, the most plentiful being a very slender and fragile one without raphe or central nodule, but with a sort of milled edge all round it. Some of the ordinary forms,—*Pleurosigma angulatum*, for instance,—with both raphe and nodule, were tolerably common, while an occasional specimen of *Pleurosigmata lanceolatum* turned up, and also a few fragments of *Bacillaria*.

A fine large form of *Coscinodiscus* was also got in this clay. It was perfectly flat, with a thin transparent ring round it, and the whole surface covered with fine honeycombings, without any appearance of pattern, or any central marking. This form is common in many of the clays of the Perth basin. A curious little *Coscinodiscus* was also found, which I had not seen before, and could not find a name for. It was a deep little box with a broad rim, the middle filled up with honeycombings arranged regularly round a central hexagon.

Another rather common diatom in this clay is a little *Surirella*, known as *Surirella plicata*, a broad-pointed oval disc, with a beautiful narrow-beaded edge, and three transverse bands across it, with portions of other bands at the two points. Two curious objects were also found in this clay looking like interlaced threads of glass. They seemed to be the edges of the box formed by some diatom, but the diatom itself did not turn up. A form of *Surirella plicata* was also found which was not pointed, possibly one in a transition state. There were also plenty of sponge spicules, broken and entire, and a pretty little marine diatom, somewhat like a *Navicula*, but nearly as broad as it was long; several *Naviculæ*, both fresh and brackish-water forms; *Pinnularia*, *Melosira*, *Gomphonema*, *Epithemia*, and other distinctly fresh-water diatoms, but all differing more or less in form from those at present found in the Tay. It would appear from the above that at the period these were deposited the water had been shallow, and the adjacent banks had been overflowed by the river, which had deposited vegetable matter and fresh-water diatoms there at flood tide.

Above this is a thick bed of sandy clay largely intermixed with vegetable remains, portions of reeds, sedges, and willows, birch stumps and trunks of oak trees. It is very compact, and when dry resembles soft carboniferous sandstone in appearance. In this no diatoms were found—even the universally-present *Spongiolithis* being absent. Resting on this is a layer of clay, with little admixture of sand, but containing vegetable debris, and a few crystals of smoky quartz. In this none but fresh-water diatoms were discovered, such as *Pinnularia* (some of them very large), *Eunotia*, *Epithemia*, *Navicula*, *Melosira*, and our constant friend *Spongiolithis*, but not a single brackish or salt-water specimen, showing that for some considerable period the sea had receded, leaving the channel of the river much higher than at present, and quite above the influence of the tides as far as the mingling of the waters was concerned.

This, again, is covered by the Friarton brick clay, a very sandy material, containing very few diatoms and a few fragments of *Spongiolithis*, those which are found being brackish-water forms. One of these resembles the halves of two *Pleurosigmæ* joined together in a line, with the curls at the ends both pointing to the same side, and a stricture in the middle—a curious-looking object, the name of which I have been unable to ascertain.

The next higher clay to which I could obtain access was that in Priory Place, where, at the time the sand beach of Craigie was formed, the water must have been about 15 feet deep. This clay is very sandy and much impregnated with carbonate of iron, but nothing was found in it but a few sponge spicules.

Another low-level clay was turned up lately in County Place, one of the lowest-lying portions of the district, and in this evident track of a former channel of the river quite a deposit of fresh-water diatoms was expected. None, however, of any description were found; but the *Spongiolithis*, as usual in lower depths, appeared in small numbers.

The next higher in point of position that was examined was taken from the street in York Place, opposite to the Infirmary, during some repairs to pipes. It was of an ochry yellow colour, and abounded with fresh-water forms of diatoms, among which some beautiful large specimens of *Surirella plicata* were found, some of *Gomphonema* and *Nitzschia*, and also several brackish-water forms of *Pleurosigma* and *Navicula*. Several *Melosiræ*, *Nitzschiæ*, and *Pinnulariæ* were also found, as well as a beautiful marine diatom of a rich brown colour, shaped like a round bead, and covered with delicate and intricate markings, too minute to be seen except with very high powers, and not well seen with them on account of the globular shape throwing all but a small portion out of focus. What corresponds to the perforation of the bead is found with the high powers to be a delicate membrane, also finely marked. I have not ascertained the name of this diatom.

The next clay in order of height was at the site of St Catherine's Chapel, near the top of the Old High Street, where at a depth of 12 feet a dark blue clay was found, containing quite a number of fresh-water diatoms, among which were some magnificent specimens of *Eunotia* and *Pinnularia*, and a great many of *Melosira*, some of them single and others connected in rods. Among them was a fine brackish-water *Zygoceros*, a large square-shaped diatom with projecting corners, the body being a high rounded disc with two transverse bands and covered with very numerous minute markings, only to be seen with a high power. Some large specimens of *Nitzschia* were also found, and sponge spicules of various forms.

Above this were beds of yellow and blue clays intermixed, and in these, especially the blue, diatoms were very numerous, especially marine and brackish-water ones. Conspicuous among these were the *Pleurosigmæ*, some very large and some very small, but all very delicate, and difficult to pick out and mount. Many diatoms of the same sigmoid shape, but without the central nodule and raphe, and prettily marked along the edges, were found of all sizes, but invariably long and narrow. Another marine diatom, *Isthmia inervis*, was found here; and large numbers of a very common but very pretty brackish-water one, *Nitzschia constricta*. Another common brackish-water form is very plentiful here, but I have not been able to ascertain the name, and I have not found it elsewhere in Perth. It much resembles *Surirella Caledonica*. It is very beautifully marked with minute dots converging towards the centre, and is of an ovoid form, with pointed ends—one surface being flat and the other convex. There are also quite a number of *Actinoptychus*, a flat circular diatom, the surface of which is divided by six raised ridges into six compartments, the three alternate ones of which are on the same level and finely spotted. Perhaps the most common of all are two or three forms of *Coscinodiscus*. One of these has its minute hexagonal markings arranged somewhat like the engine-turned pattern on a watch-case; another has its somewhat larger markings placed without any definite arrangement, while a third has them arranged in a series of curves or segments of circles, the concave sides directed towards the circumference. There are also considerable numbers of the brown bead-like diatom formerly mentioned, all of these being brackish-water forms. Our old friend the *Spongiolithis* is also very common, but no fresh-water forms are to be seen in the upper beds of this clay.

The next higher clay examined was that in the brickyard which now forms the site of the New Auction Mart, but here only one diatom was found—a marine one—besides some sponge spicules. In the highest clay of all, taken from behind the Poorhouse, 2 feet from the surface, only a few small diatoms were met with, and some broken fragments of sponge spicules.

In none of the clay beds examined were any calcareous shells found, with the exception of two Foraminifera found at St Catherine's. These, on account of their buoyancy, were both lost in attempting to mount them in balsam.

It will be evident from a consideration of the foregoing, that the basin in which the City of Perth is built, has for an immense period of time, comparatively speaking, been in most respects similar to one of the West Highland marine lochs, differing from them chiefly in having a very narrow entrance towards the sea, and in having a very large river flowing into it, rendering its waters to a great extent brackish. It is also evident that the red glacial clay, without any remains of organic life, has been the original bottom of that loch, which has gradually silted up by deposition of the mud brought down by the river, till nearly forty feet of clay was deposited over its bed, during which time countless millions of minute organisms which can only exist in brackish water lived and died during thousands of years—for in thousands of years only could such a depth of mud have been deposited over such a large area. These organisms have left silicious skeletons of the most beautiful construction and most elegant and intricate ornamentation to tell of the marvellous power of their Creator, who could dispose of so much grace and regularity of ornament and design where it cannot be seen with the naked eye, but can in many instances be revealed only by the very highest powers of the microscope.

It appears evident also that the level of the land of this country had rapidly changed, in two successive upheavals of about 25 feet each, and that from the deep bed of clay that had thus filled up the Perth basin, the river had, by successive changes of its position, gradually worn away the major portion of this clay deposit, till, having attained its present level at about the level of the sea beyond, it can now get no lower unless the land again rises, and gives it the power to cut out a deeper channel.

On reference to the Ordnance Map, I observe that the lower plain on which the larger portion of the city of Perth is situated has an average height of 17 feet above sea-level. The higher plain or haugh along the eastern and northern sides of the Perth Basin, in which the diatoms are of marine or brackish origin, averages 35 feet, and the various sandy beaches outside of this about 45 feet.

## December 3rd, 1885.

F. Buchanan White, M.D., F.L.S., President, in the Chair.

### NEW MEMBERS.

The ladies and gentlemen nominated at last meeting were duly elected members of the Society.

The following were nominated for election at next meeting:—Mr Charles S. Sandeman, Springland; Mr Andrew Calderwood, Kilmartin Place; and Miss Stirling, Athole Place.

### EXHIBITS.

Mr H. Coates exhibited the following:—

1. Turnip grown in the Manse Glebe, Scone. This turnip had grown through the link of an old chain, which had been lying in the ground at the time the seed was sown.

2. A series of marine shells collected in the Firth of Forth by Mr F. Smith, a former member of the Society. These included some scarce species and varieties, as well as exceptionally fine specimens of some of the commoner species. Amongst the former were *Natica Islandica*, *Trophon truncatus*, *Solen pellucidus*, *Purpura lapillus* var. *imbricata*, and *Mytilus edulis* var. *pellucida*.

### DONATION.

The following donation was intimated:—Sparrow-hawk, killed at Newmiln—from Mr James Rollo, Rosemount, Perth.

### REPORT OF THE DELEGATE TO THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.
REPORTED BY MR ROBERT PULLAR, F.R.S.E.

Mr Pullar, in the course of his report, gave an interesting account of the meeting of the British Associatien held in Aberdeen last summer, and, more particularly, of the work of the Committee on Corresponding Societies. He dwelt ou the importance which this Committee attaches to the work of the local Societies being conducted on thoroughly scientific methods, and to the publication of a record of the work done, in the form of "Proceedings."

### REPORT OF THE DELEGATES TO THE SECOND ANNUAL MEETING OF THE EAST OF SCOTLAND UNION OF NATURALISTS' SOCIETIES.
REPORTED BY DR BUCHANAN WHITE, F.L.S.

The second annual meeting of the East of Scotland Union of Naturalists' Societies was held, as had been arranged, in Kirkcaldy, on the 4th and 5th of September last, and both the delegates (Mr R. Pullar and myself) from this Society were present. The official meetings of the Union were as follows:—On September 4th, a Council Meeting and the Annual General Meeting; on September 5th, two excursions and a meeting to receive the reports of the excursions. At the Council Meeting the following Societies were represented:—Aberdeen Natural History Society, Arbroath Horticultural and Natural History Association, Dundee Naturalists' Society, Kirkcaldy Naturalists' Society, Largo Field Naturalists' Society, Montrose Natural History and Antiquarian Society, and Perthshire Society of Natural Science. After a long discussiou on the affairs of the Union, it was agreed to recommend for the adoption of the Union the following resolutions:—

1. That the assessment for 1885-86 should be fourpence per head.

2. That the reports and proceedings of the Union should be published in the *Scottish Naturalist*, and afterwards separate copies re-printed for the use of those members who required them; and that towards the expenses of publication a sum not exceeding £10 be paid from the funds of the Union.

3. That the next annual meeting be held at Aberdeen,—the time of meeting to be fixed by the Aberdeen Society.

These recommendations were afterwards agreed to at the general meeting. As the full purport of them may not be understood by all members of our Society, we wish to devote a few words in explanation.

As at the founding of the Union, and in last year's reports, a detailed account has been given of the objects for which the Societies of the East of Scotland have associated themselves together, it will be sufficient to remind this Society that these objects are joint-action and co-operation in working out the natural history of the district. By such joint-action not only will much unnecessary labour be avoided, but much expense saved in printing and publishing. Therefore, though at first sight the expense of the assessment that we, as a Society, have to pay to the Union, may seem to be disproportionate to the value received, this is by no means the case when it is considered how much labour is thereby saved to the individual and how much expense to the Society. A little thinking

ought to convince everyone of this fact. It is true that as yet it has chiefly been a case of paying out and not getting in, but as the Union is only in its second year the results of some of its work are not as yet apparent. I mean as regards the publication of what has been done in the joint-work of investigating the natural history of the district. But though it has not been possible to publish, as yet, much on this subject, a lot of work has been and is being done, as future years will show. In the meantime good has been done by the Union in another direction, namely, in the impetus it has given to the various Societies connected with it.

The delegates assembled in Council found that in all the Societies there had been a good deal of complaint about the assessment for the first year. Whilst thinking that this complaint was unwarranted, they spent a considerable time in discussing the means by which the assessment could be reduced. The expenses of the Union are almost restricted to the expenditure necessary for printing and publishing the Reports and Proceedings, and it is absolutely necessary for the sake of the work of the Union that these should be published. As has been mentioned, it was finally agreed that the Reports, &c., should be published in the *Scottish Naturalist*, which would thus become the authorised organ of the Union. But as it is desirable for several reasons that the Reports should also appear as a separate publication, it was arranged that a certain number of reprints should be flung off. Towards the expenses of this method of publication it was resolved that a sum not exceeding £10 should be paid by the Union. The question of a future diminution or increase of the assessment now remains in the hands of the members of the various Societies. If they choose to support the authorised organ of the Union by subscribing thereto, the assessment will be diminished, as by an increased circulation more space can be given to the Reports without calling upon the Union for a subsidy. One word with regard to the separate copies. It will be remembered that last year copies of the Reports were distributed to the members of the Societies without charge. How many copies of these were put aside or destroyed without being read, we are unwilling to think. The number of copies printed (or rather reprinted) in future will depend upon how many each Society requires; and each Society will dispose of them to its members in the manner it chooses. In this way every member who wishes for a copy, and gives notice in time, will be able to obtain one at a small expense. One thing we would ask on behalf of the Union, and this is that, as the plan sketched out above is only in course of being tried, members will be lenient in judging of its operation during the first year.

As regards the other resolution of the Council mentioned above, viz., the place of meeting for next year, we, as delegates of the Perth Society, considered it unadvisable to put forward the claims of Perth as next year's meeting-place. The district of the Union stretches from the Firth of Forth to Banffshire, and it is desirable that the meetings of successive years should not be in places approximate to each other. The Council, we believe, would have been willing to select Perth as the next meeting-place, but for the welfare of the Union every member concurred in recommending Aberdeen as the place of meeting. If this Society invites the Union to meet in Perth in 1887, we have no doubt but that the invitation will be cordially accepted.

Amongst other business transacted by the Council was the appointment of Dr Howden, of the Montrose Society, as delegate of the Union to the British Association for the Advancement of Science, whose meeting was to be held in Aberdeen,—this appointment being necessary in consequence of the Union having been recommended for election as one of the Corresponding Societies of the British Association.

In returning thanks to the various members who had given in the various Scientific Reports, the Council agreed to recommend that the authority given to the various Reporters should be continued, and that the further Reports should be made on the lines sketched out in the first Presidential Address. This recommendation was subsequently adopted at the general meeting. A Publication Committee (with full powers) was appointed, and it was agreed that the assistance of members of all the Societies should be asked to work up the bibliography of the natural history of the district. As one of the Publication Committee, I desire to bring this matter—the local bibliography—before the members of this Society, with a view to obtaining assistance. An indefinite number of scattered notes relating to the natural history of the East of Scotland will be found in various books and periodicals. For a thorough elucidation of the natural history it is necessary that these be collated. If the Reporter on any one subject sets to work to find out for himself all that has been written—with regard to the district—on his subject, he has no enviable task before him. But if members will undertake to go through certain books or periodicals, and make notes of all local references therein, this division of labour will render the work comparatively easy. I wish, therefore, to ask volunteers in this work in our Society. I will give an illustration of what I mean. There is an interesting work called the "Statistical Account of Scotland." The Reporter on Ornithology, we will say, for example, wishes to

note all local references to birds in this work, and in so doing comes upon a number of references to other groups, which, as they are not in his department, he ignores. So likewise with the Reporters on Mammals, on Shells, on Plants, &c., each of these going over the whole work. Now, if instead of four or five or more persons each going over the Statistical Account, one person would do so and note the page and nature of each local reference, a great deal of time and labour would be saved, as each of the Reporters would merely have to look at the notes made to find out the references relating to his own subject. Without assistance in this way from other members than the Reporters, a long time must elapse before we can work up the important subject of the bibliography. Any of our members who wish to assist will please communicate with me.

At the general meeting, the President for the year, Professor James Geikie, having delivered a highly-interesting and instructive address, several papers and reports were submitted and discussed.

The address and other communications will be published forthwith in the *Scottish Naturalist.*

On September 5th, two excursions were made. One consisted of a dredging expedition in the Firth of Forth; the other being a land excursion to Kinghorn and Burntisland. In the evening a meeting was held at which reports of the excursions were given in and specimens exhibited.

Though the meetings alluded to above formed the regular routine of the Union, we must not fail to mention the very successful conversazione given by the Kirkcaldy Naturalists' Society in honour of the Union, and to which the members of all the other Societies were invited. Nor can we conclude this Report without a grateful remembrance of the generous hospitality so freely given to visitors by the members of the local Society. The whole arrangements of the meeting were well planned and successfully carried out, and though many members of the Kirkcaldy Society merit the thanks of the Union for their work in connection with the meeting, they will, we are sure, agree in testifying that to no one is it indebted more than to the Honorary Secretary, Mr W. D. Sang.

The following paper was read :—

"*The 'After-Glow,' or Extraordinary Sunsets of 1883-4.*"
By the Rev. R. Graham, LL.D., Errol.

That the after-glow which was observed over the greater part of the world during the latter part of 1883 and the whole of 1884 was a really exceptional phenomenon, and not the result of specially serene and fine evenings, is now conceded by all who have directed any measure of attention to the subject. The appearance of the sky immediately after sunset was so striking, the glory so long continued, and the colours so peculiar, that every one felt they were beholding something different from, and altogether beyond, an ordinary sunset. The whole western heavens were on serene and clear evenings literally ablaze with gorgeously-coloured light, in which the red, and yellow, and purple colours were often blended and intermixed in the most extraordinary and beautiful way. Even on those evenings when the sky was overcast the existence of abnormal light could be inferred from the longer continuance of the twilight, and from a tinge of greater warmth than usual in the clouded sky. Fortunately, we have notes of observations and descriptions of the phenomena by competent observers from widely-different localities; and from the observers in them all the report is the same, the appearance of the sky was exceptional and extraordinary; whilst in many cases the gorgeous beauty was declared to baffle description. The glow was seen with equal vividness and splendour along the coast lines, and in the interior of the great continents. After continuing to be a very grand and striking phenomenon for nearly a couple of years, it disappeared with something like the same suddenness with which it had appeared in 1883. To what then are we to ascribe it? How can we explain, on the known and recognised principles of science, an occurrence so singular and beautiful?

One explanation which has found much acceptance with men of no small scientific attainment, is, that the after-glow—as it has been called—was the result of an enormous amount of the finest volcanic dust suspended in the higher regions of the atmosphere, which, refracting and reflecting the sun's rays much more than the thin air of the higher regions of the atmosphere usually does, occasioned the phenomenon.

This theory has found much favour from the fact that, shortly before the glow appeared, one of the most violent volcanic eruptions of modern times occurred at Krakatoa in August, 1883. The eruption was remarkable not only for its violence, but also for the wide area over which it extended, and for the enormous amount of matter ejected into the atmosphere. Fortunately for science, two days after the greatest outburst occurred, the barque *Arabella*, with a scientific observer on board, was sailing about 1000 miles to the leeward of Krakatoa, when a quantity of volcanic dust fell upon her deck. Mr Stanley analyzed the forms and dimensions of the particles to ascertain their floating and optical properties, and found them to

consist of pumice of an extraordinarily light kind. They were what he terms overblown, *i.e.*, the ordinary air-bubbles that are in pumice were much extended, and blown so thin that they appeared to have been burst into fragments resembling pieces of broken watch-glasses. They are (says he) of extreme tenuity, being about 1-15,000th of an inch in thickness, and there can be no doubt that they are capable of floating a long time in the atmosphere in currents. That volcanic dust can be suspended in the atmosphere, and carried great distances, is further shewn by the fact that snow which fell at Philadelphia in America about two years ago, on being melted and evaporated, was found to contain undoubted volcanic particles; and it was believed that these might have come from Krakatoa, a distance of 10,000 miles. It was, however, still more probable that they had come from Alaska, in the N.W. corner of America, where a great eruption occurred on the previous summer. Whilst, then, there are many well-authenticated cases which shew that volcanic matter in inconceivably minute particles and filaments may be projected far up into the atmosphere, and may float in it for a long time, and be carried to great distances, when we come to apply this fact to the explanation of the glow, and seek from it a satisfactory reason for its long continuance, its extraordinary brilliancy, and the immense area over which it extended, we are met with many and formidable difficulties.

Not the least of these is the consideration that, to explain the phenomenon, the volcanic particles must be supposed to have been driven to the very highest regions of the atmosphere, and to have floated there for many, many months. To suppose them to have an elevation of ten or fifteen miles would not at all account for the appearances presented, since the refractions through those of them which were transparent, and the reflection from those which were opaque, would not at such an elevation have extended the glow to the time after sunset to which we know it did extend. They must have had an elevation of 30 or 40 miles from the earth's surface to explain the elongation of time and the other phenomena witnessed. But at 30 or 40 miles from the earth's surface the atmosphere is so thin and rare, so nearly approaching a vacuum, that it is utterly inconceivable that any solid matter, however attenuated, could remain for weeks and months suspended in it.

Besides, how can we conceive of a force sufficient to project atoms so minute to such regions? Terrific though the forces of a volcano are, consider for a moment what the theory under consideration requires them to do. They must propel atoms of matter so minute that only a high-power microscope can make them visible, through 30 miles, or the greater part of the atmosphere of the earth,—and that, too, in direct opposition to the action of gravity,—a feat which no initial velocity we can conceive of could accomplish with particles so minute. Had the particles been each the size of a man's fist and a couple of pounds in weight, they might have been driven the distance, or even beyond it. An illustration of what we mean may be taken thus:—A piece of ordnance, if loaded with a full charge of powder and a heavy projectile, will carry 12 or 15 miles; whilst the same gun, with the same charge of powder, will not drive a mass of snipe-dust, of the same weight as the projectile, more than a few hundred yards.

No doubt the action of an active volcano is considerably different from that of a gun, since over the vent of the volcano there may be conceived to be an enormous column of heated air rushing up through the more solid atmosphere, up which chimney (if we may so regard it) there rushes prodigious volumes of heated air, and dust, and steam, and smoke. In this way it is quite conceivable that the minute particles found on the deck of the *Arabella*, and in the snow at Philadelphia, were carried high up into the atmosphere, and floated by its currents many hundred miles; but that they should have been so elevated beyond 6 or 7 miles is quite impossible. Beyond the scirrhus clouds 5 or 6 miles from the earth, we have reason to believe that the currents in the atmosphere are very faint indeed; and at 15 or 20 miles they altogether cease to exist. Volcanic particles, therefore, though they found their way to such a region, would change their longitude and latitude with extreme slowness. Now, if volcanic dust from Krakatoa occasioned the glow, it must in some unaccountable way have found its way through the higher regions of the atmosphere, all round the globe, in the shortest space of time, since the glow suddenly and simultaneously, and with equal brilliancy, appeared in all the countries of the earth.

But, formidable though the difficulty to the dust theory which we have just stated is, there is another and much more formidable one, which stares us in the face, viz., the quantity of dust which would be required to produce the phenomena. The idea of its being ejected from a single volcanic eruption, however great that eruption may have been, has only to be stated in order that it may be discarded. The area of the earth's surface is about 200 millions of square miles, and the atmosphere over this immense area to be filled with minute particles, in its higher regions, so as to produce the phenomena of the glow, must have had not one Krakatoa in eruption for a few days, but many volcanoes belching forth their contents for many months.

Though a volcano may eject much matter in the form of lava, and smoke, and steam, we must remember that it is with its most finely-divided products that we have now to do—namely, that which is capable of remaining suspended in an atmosphere approaching vacuum. That one eruption, though it may have had 50 vents, should have thrown up such quantities in a few days, and that it should at once have been diffused all over the outer area of the earth's atmosphere, is simply inconceivable.

Whilst we see formidable objections to the volcanic dust theory, it must be confessed that some of the objections advanced against it are hardly valid. A gentleman resident in the Transvaal states that he was led to abandon it, because the glow continued as splendid as ever after long-continued and heavy rain which had prevailed in that region of Africa. He believed that the dust could not be the cause, since the rain must have thoroughly washed it out of the atmosphere ; but he forgot that the theory supposes the dust to float far above the region of the rain-clouds. These never rise above 7 or 8 miles, whereas the theory requires the dust to float at four times that elevation. At such altitudes there could be no rain to wash it down. For these reasons, we fear that the volcanic dust theory must be abandoned. But another has been advanced, which appears to us to merit no lengthened consideration. The glow has been ascribed to the existence of aqueous vapour in the higher regions of the atmosphere; but how it can reach the regions in which it must exist to produce the effects witnessed, and how it could continue, even if it reached them, is not explained. Aqueous vapour would undoubtedly produce the refractions and reflections the sun's light would require to undergo to produce the glow, because it is by it that the frequent glories of an ordinary sunrise and sunset are occasioned. But to produce the true phenomena of the glow,—to occasion that which made it different from an ordinary sunset or sunrise,—the aqueous vapour would require to be extended prodigiously upward, even to regions where we have no reason to suppose it could by any possibility exist. Aqueous vapour is sublimated into the air from the surface of the sea and from the moist earth by the heat of the sun. It can remain suspended only in comparatively warm air,—by no possibility can it continue as vapour in intense cold. One diminution of temperature reduces it to rain, and a lower to ice and snow. Now, we know from the testimony of our mountain-climbers and aërial voyageurs that, as we ascend into the atmosphere, the cold rapidly increases, until, at the elevation of a few miles, it becomes unendurable by human beings. The breath falls as snow from the mouth and nostrils at 5 miles up, just as it does in Melville Island during the depths of an Arctic winter. Even under the Equator the snow-line is only a few miles above the sea-level. Vapour of an aqueous kind in the higher regions of the atmosphere is, therefore, an absolute impossibility,—it can no more exist than snow could in a heated furnace. In ascending upward from the earth's surface, we soon rise completely beyond the region of the clouds, and reach spaces where the atmosphere is so cold and attenuated and still, that every kind of life, and matter in any palpable form, can hardly be conceived of as existing :—and as we ascend, the cold and attenuation and silence increase, until we reach a region where the atmosphere, from its infinite attenuation, ceases altogether to exist, and absolute vacuum begins. That point has not with minute scientific accuracy been determined, but it is generally supposed to range from 40 to 60 miles,—although so high an authority as Dr Ball believes that it may be more than a hundred. Indeed, the boundary line—if we may so call it—must be continually changing, since there is a daily tidal wave in the ocean of the atmosphere, similar to, and produced by the same causes as, that in the sea;—and beyond this slight daily change, there are gigantic atmospheric waves, occasioned by the unequal heating of the earth's surface by the sun, and other causes, which sweep round the globe, the varying depths of which we are enabled to read by the fluctuations of the barometer. Still, making allowance for these changes, the boundary between absolute vacuum and the atmospheric surface is usually confined between these extremes we have mentioned. Now, since, as we have shown, the matter occasioning the glow must exist in these extremely exalted regions of the atmosphere; and since, as we have farther shown, neither solid matter, however minute, or aqueous vapour in any form, could remain suspended in them, the question arises—By what was the glow occasioned? How is its existence for a definite period to be accounted for ?

The theory we have to propose is, that the sun and his attendant planets, in their grand flight southward in the direction of the constellation Hercules, passed through one of those nebulous or cometic fields, or masses, which we have reason to believe exist in the interstellar spaces. That the atmosphere of the earth coming in contact with such matter, and in its upper regions being permeated or blended with it, would be in the condition to produce the phenomena of the glow, will, we think, be readily granted. So that the main point in our endeavour will be to show that such nebulous or cometic masses most probably exist in the vast fields of space around us, and that it is not improbable that our system during the continuance of the

glow passed through one of them. That the vast inter-planetary, and the still vaster inter-stellar, spaces, are not absolutely void, is now conceded by our highest authorities. Ether, or whatever else we choose to call the medium through which light is transmitted, manifestly fills all space. However far in imagination we may extend the confines of the universe,—reaching outward in every direction,—beyond one star system after another, all but indefinitely, we cannot imagine our reaching a region through which light cannot pass, or where this all-pervading element does not exist. Certainly, also, matter in a much grosser form than this impalpable element exists in the interplanetary spaces, for, in her flight round the sun, the earth is continually peppered or battered with minute masses of matter, which are known as meteors, or aërolites, as shown by the meteoric shower on the night of the 27th November last, and many other occasions. These bodies, varying in size from a boy's marble to masses a couple of tons in weight,—though generally of very small dimensions,—have a high velocity, and move in regular eliptical orbits around the sun. Occasionally the earth's orbit crosses the orbit in which a great stream of them is moving, taking about five hours to pass through it; and as the earth and they meet each other, and both when they do so are moving at the rate of 18 miles a-second, the prodigious velocity with which they plunge into the earth's atmosphere induces such a heat from friction that they are in a second or two sublimated into vapour. They are only seen by us when they are in the act of perishing. When the original mass, however, is so great that it has not time to be burnt up in its rush through the atmosphere, it falls with terrific force to the earth,—fortunately for the earth, the fall of such bodies is extremely rare. But whilst such bodies are known to exist, and to move individually and in groups around us and through the interplanetary spaces, it is well known that there are enormous fields of nebulous-looking matter existing in the celestial abysses, which, because they cannot be resolved into star systems by our finest and most powerful telescopes, are believed to be composed of matter in its most rudimentary state. It is seen in large instruments as a faint puff of smoke against the black void beyond, from which no light comes. It is supposed to be prodigiously attenuated, so that the lightest of our known gases are dense when compared with it.

From these enormous nebulous masses which lie away out into the prodigious depths of space, according to the theories of La Place and Herschell, suns and worlds have been evolved, and are now being evolved, in those mighty cycles through which the work of creation is supposed to extend. The nearest approach to this nebulous matter of which we have any knowledge is the matter of which those comets which visit our region of the universe are composed; though it must be confessed that our knowledge is limited indeed. We can only conceive of nebulous matter by giving to it a somewhat similar consistancy and similar properties to that which we are led to give to comets, from the observations made in recent years upon these strange wanderers. The main difference between them is that the nebulous mass is comparatively quiescent, whilst the comet is usually—though, as we shall afterwards shew, not always—in a high state of motion.

The few properties we know cometic matter to possess are the following. It has in a high degree the power of reflecting the light of the sun which falls on it; hence the extraordinary splendour many comets discover when placed in a favourable position. It is attenuated, and thin, and rare, beyond any form of matter of which we have any experience. A striking illustration of its rarity is furnished by the fact that in 1858 Donati's comet passed over the star Arcturus on a beautiful October evening, but the faint light of the star was not obliterated even when the nucleus, or head of the comet, passed over it. Now we know that the feeble light of Arcturus must have passed through 1,200,000 miles of the densest part of the comet; yet there the star twinkled on, but little dimmed by the intervention. How inexpressibly thin and rare, then, must the matter of the comet have been to enable it to do so. The thinnest and most fleecy cloud will obscure Arcturus, a puff of smoke from a workman's pipe will do it, yet more than a million miles of the comet's head failed to do so. As an illustration of the lightness of comets, we may mention that some 30 years ago a comet passed near the planet Venus; and although the most careful observations were made, with the most delicate instruments, it was found that the planet was not in the slightest degree deflected from its course by the vicinity of the ethereal wanderer. The planet disturbed the comet,—but the comet had so little solid matter in it that it could not disturb the planet. Many, even in modern times, have been alarmed for the consequences of the earth coming in contact with a comet,—but the apprehension is groundless, since the earth's atmosphere, which is so much more dense than a comet, would effectually protect it. The most that could happen would be a few and harmless atmospheric disturbances, and possibly a series of glorious after-glows so long as the collision lasted. The number of comets connected with the solar system is known to be above 200, though there may be many more which have not been observed. But we have no reason to suppose that these

strange and mysterious objects are confined to our region of the universe. Away out in the vast interstellar regions,—those vast fields through which our sun with his attendant train of planets is now sweeping,—they are rushing in all directions, and would be found in various conditions. Some we may suppose to be in a formative state, the matter of which the future comet is to be composed being enormously diffused, and in the act of being drawn together and condensed, in order that, in its more compacted state, it may feel the influence of some far-distant attraction, and start from its former quiescence upon an impetuous course, as a comet around some distant sun. But whilst enormous areas of interstellar space may contain this cometic matter from which new comets are being formed, other spaces may—indeed, we know, must—contain comets which have lost themselves. Astronomers know that many years ago a comet got entangled among the satellites of Jupiter and was thrown completely out of its course, and sent at last along the arm of a parabola, never again to return to this region of the universe. Such an accident must be no uncommon occurence, when we consider the number of comets, and the risks they run in rushing through the planets of a system. A very small planet—or even a satellite—would be quite sufficient to deflect their path if they came near it, so that they would never return upon themselves. Even two of them passing near each other might so alter their orbits as to send one or both of them out into those vast abysses of space, where they would be lost,—where they could only wander aimlessly, waiting, as it were, for some new attraction to influence them. A lost comet being all but entirely freed from the forces which formerly impelled it, and as it were held it together, and being away out into those abysses of space where it was feebly assailed by distant and opposing attractions from the nearer surrounding suns, may be supposed to expand itself, and go back again to the nebulous mass, from which it was originally formed. The forces which compacted it, and sent it on its impetuous course, being spent, it would naturally return to its pristine state. Such appears to be the only condition in which a lost comet may be expected to be found.

If we have succeeded in shewing it possible—if not probable—that these cometic masses exist in the interstellar spaces, we have to some extent prepared the way for the understanding of the theory we have advanced, as an explanation of the phenomena of the after-glow. We suppose that the sun in his gigantic sweep southward, passed, with his attendant train of planets, during the continuance of the glow, through one of these vast cometic fields; and that during that time the upper regions of our atmosphere were in contact with the cometic matter, by which it was practically enormously deepened, and the light of the sun was for a much longer time refracted or bent down towards the earth. The theory we have advanced will neither be understood nor appreciated unless the enormous difference in density between the atmosphere and cometic matter, as we know it to exist, be kept in view. Living as we do at the bottom of an atmospheric ocean 50 miles deep, we are apt to think of atmospheric effects as they are seen and felt around us, forgetting that the atmosphere becomes thinner and rarer as we ascend, until it ceases altogether, and absolute vacuum (so far as the atmosphere is concerned) prevails; so that phenomena which are possible in one depth, are absolutely impossible in another. In the extremely rarified air of the upper regions, where vacuum was being approached, even such rare and attenuated matter as that of which comets are composed could be absorbed for a certain depth into it. They could for miles downward be blended together, and that so gradually that it would be impossible to tell where the effects produced by the one ended, and those by the other began. It was the practical deepening of the atmosphere for many miles, by its being overlaid with the cometic matter, and being blended with it, which refracted or bent down the rays of the sun (which after sunset ordinarily pass clean over the atmosphere), causing the twilight glories to be continued for nearly an hour longer than they usually are, and which occasioned the extraordinary brilliancy of colour which was one of the most striking characteristics of the glow.

In confirmation of the theory we have advanced, it may be mentioned that, during the continuance of the glow, telescopes, when applied to celestial observation, came short of their usual definition. The best instruments wanted that clear and sharp distinctness which is one of their highest properties—a circumstance which the contact of nebulous matter with the atmosphere easily accounts for.

But it may be said that the nebulous or cometic field, the theory supposes, must have been very large, since the earth and sun required nearly two years to sweep through it. But this objection will not be formidable to those who in any way have tried to apprehend astronomical distances and magnitudes. Though 20 years instead of two had been required, the field would have been a small one compared with many we know to exist in the depths of space.

7TH JANUARY, 1886.

F. BUCHANAN WHITE, M.D., F.L.S., President, in the Chair.

NEW MEMBERS.

The following were elected :—

Mr Charles S. Sandeman, Springland ; Mr Andrew Calderwood, Kilmartin Place; and Miss Stirling, Athole Place.

Mr F. H. White, Annat Lodge, was nominated for election at next meeting.

DONATIONS.

The following were intimated :—

A large collection of mosses (Perthshire, British, and European), including most of the British species—from Dr Buchanan White; a large and interesting series of nests and eggs collected in the district of Rannoch—from Mr John M'Douald, gamekeeper to Sir Robert Menzies, Bart.; twin salmon caught at Stormontfield ponds by the late Mr Peter Marshall—from Mrs Marshall, Barrack Street; geological specimens—from Dr Trotter and Mr R. S. Trotter.

*Note on Collection of Nests and Eggs presented to the Museum by Mr John M'Donald.* By Col. Drummond Hay, C.M.Z.S.

The Curator has to report the receipt of a valuable consignment of nests and eggs from the district of Rannoch, collected by Mr John M'Donald, gamekeeper to Sir Robert Menzies, Bart. (by kind permission of the latter). Many of these were got in 1884, but, there being no good opportunity, could not be forwarded until now. In making this report, the Curator would especially draw attention to the very careful manner in which those nests placed on the ground have been lifted, the sod having been taken up with them, by which means the character of each individual nest has been entirely preserved. This could not otherwise have been the case, as these ground-nests are for the most part mere depressions in the soil (either natural or scratched out by the bird, or made by its own weight) or in some tuft of moss, grass, or heather, with merely the surrounding materials used as a lining, and where these are thin and scanty the character would have been entirely lost. Mr Macdonald, therefore, deserves the cordial thanks of the Society for the great pains he has taken in thus securing, as far as possible, a correct representation of the nidification of our birds—an object so particularly to be desired, and so much at heart in the Society's wishes.

The list being a long one, the Curator merely mentions those that are new to the Society's collection.

RAVEN. Nest and Eggs.

LONG-EARED OWL.

The nest which this bird had taken possession of *(it never builds one of its own)* proves to be that of a hooded crow of the previous year. This is the usual nest of its adoption, though that of the wood-pigeon is sometimes used, also that of the heron, and it has even been known to take possession of a deserted squirrel's "drey." The nest now sent had two eggs in it, which were forwarded last year, and are now in the Museum. The usual number deposited is five or six, which are often laid early in March, and sat on as soon as laid, as is the case with many other birds of this family, young birds and fresh eggs often being found together in the same nest.

MERLIN. Nest with 4 Eggs.

This is a ground nest, a site often chosen when breeding on the moorlands among tall heather, though some flat spot among rocks on steep slopes at the foot of precipitous ridges is also frequently selected.

KESTREL. Nest with 5 Eggs.

RED GROUSE. Nest and 7 Eggs.

BLACK GAME. Nest and 7 Eggs—had 8 when found.

GOLDEN PLOVER. Nest and 4 Eggs (complete).

REDSHANK. Nest and 3 Eggs.

Four were found in the nest; one broken in blowing.

GREENSHANK. Nest and 3 Eggs.

CURLEW. Nest only.

The eggs (4 in number, the full complement) which were in this nest were forwarded last year, and are now in the Museum.

COMMON GULL *(Larus canus)*. Nest only.

Eggs sent last year, which were the ones deposited in it when found, and are now in the Museum.

HERRING GULL. Nest only.

The eggs belonging to this nest were sent last year, and are now in the Museum.

HERON. Nest with 4 Eggs (complete).

This bird builds on an island in Loch Lydon, which was visited by Colonel Drummond Hay in company with Sir Robert Menzies in 1884. At that time, however, the nests were found to be so large—being mostly built for many generatious one on the top of the other—that it was quite impossible, in the limited time, to select one suitable for the Museum. John M'Donald was, therefore, directed to try to get one in the spring of this year—a task which he has now most successfully accomplished.

BLACK-THROATED DIVER. Nest and 2 Eggs (the full complement).

This may be called the treasure of the collection. The Black-throated Diver is often mistaken for the Great Northern Diver. Keeping far out on the loch, and seldom admitting of a close inspection, it is sometimes difficult to decide which is which, without a good glass. The Great Northern Diver, however, chiefly confines itself to the salt-water lochs and inlets on our coasts, though no doubt occasionally visiting some of our larger inland fresh-water lochs; but as yet there is no actual proof of their ever breeding in this country, though Colonel Drummond Hay has seen them in abundance, and shot them as late as the 10th of June, in the Island of Westrays, in the Orkneys, and at that time in full nuptial dress. Its nest is said to be clumsily made and slight in material, whereas that of the Black-throated, as may be noticed by the specimen, is a large and substantial structure. The eggs, however, so exactly resemble in colour those of the Great Northern, that they are not to be distinguished, especially when small examples of the latter are compared with larger ones of the former.

Many other nests not previously represented in the Museum have been sent, comprising chiefly those of the smaller birds, such as the Swallows, House-Martins, Fly-catchers, &c. Among these, one in particular is deserving of mention, namely, that of a Wren, large in size, and entirely composed of grey lichens *(Evernia prunastri)*. This nest, when fresh, must have been most difficult to distinguish from some lichen-covered stump or excrescence. Last, though not least, may be mentioned a very fine fresh specimen of a Squirrel's Nest or "Drey," half domed, with the interior (about 7 inches deep) warmly lined with wool.

The following series of papers was read :—

## THE NATURAL HISTORY OF KINNOULL HILL.

### I. INTRODUCTION.

BY DR BUCHANAN WHITE, F.L.S.

The purpose of the following series of papers may be said to be manifold.

In the first place, by showing what are the natural productions of a limited area of the central part of Lowland Perthshire, a good idea may be given of the general character of the fauna and flora of the lowland portion of the county, since the area in question is probably fairly representative, and neither much richer nor much poorer than many other parts of our lowlands.

In the second place, the series will serve to show that for purposes of field-studies in natural history, it is not necessary for an inhabitant of Perth to seek a distant locality, since in the close vicinity of the town he can find ample scope for his pursuits.

Thirdly, since the district under discussion is in the immediate neighbourhood of a place that for many ages has been an inhabited town, and has now 31,000 inhabitants, some of the influences of human agency in modifying the fauna and flora cannot fail to be shown. Thus, while some species have probably disappeared, others—especially amongst plants—have doubtless been added. But though—from the absence of records—some of the effects in question can only be more or less conjectured, yet, by making a careful record now, it will be more easy to detect the changes, due to these influences, that take place in future.

Lastly, since the papers will show how very far from perfect our knowledge of a limited area close to Perth is, and hence how still more imperfect is that of Perthshire in general, it is hoped that they will stir up the working members of the Society to renewed efforts in their special work.

The area whose natural history we are about to discuss lies immediately to the east of the city of Perth, and in fact includes within its boundaries part of the town itself. Its limits may be thus defined. Starting from the eastern end of Perth Bridge, the Muirhall Road, as far as the entrance lodge to Kinfauns Castle, forms the northern boundary. From this lodge the line goes down the Deuchny Burn nearly to the mill-dam, thence to the point of the wood west of the mill-dam, and thence along the lower edge of the wood westwards to where the Barnhill toll-bar used to be. From the toll-bar it follows the foot-path that leads to the River Tay, and thence up the river to the starting point at Perth Bridge.

The area thus defined includes about one and a-half square miles, its greatest breadth and its greatest length being about one and a-third miles.

Physiographically, the area is a hill with a gentle slope upwards from the north and west to near the east and south boundaries, where the descent is very abrupt—nearly perpendicular cliffs or very steep slopes forming this side of the hill. At the River Tay the altitude above sea-level is only about 10 feet, and the highest point of the hill is

728 feet. The aspect of the cliffs is south by south-east, and a one point their greatest nearly perpendicular altitude is more than 200 feet.

The district is on the whole a dry one. One very insignificant burn traverses about one quarter of the western slope, while the Tay bounds it on one side and a little part of the very small Deuchny Burn touches another. Nor can it be said to have any marshes within its boundaries, though there are here and there some very limited pieces of slightly damp ground. Rather more than the eastern half of the area is covered by woodland, while a strip of about one-third of a mile in breadth along the western boundary is occupied by houses and gardens, and most of the remaining portion is under cultivation.

While almost the whole of the western half is within the Parliamentary boundaries of the city of Perth, a not inconsiderable portion of the north-western corner is actually within the municipal boundaries, and forms part of the town itself.

Of the former conditions of Kinnoull Hill, we unfortunately know very little. Writing in 1774, Cant, in his edition of Adamson's *Muses Threnodie*, says that the northern and western slopes were anciently covered by a forest of oaks, "which produced the great beams in St John's Kirk above four hundred years ago." For many years before he wrote it had been little better than a barren common, but about this time (1774) the various proprietors had begun to form plantations, and to their efforts we owe the pleasant woods with which the hill is now adorned. Much of the wood, however, must be of a more recent date even than this.

In concluding this introduction, this opportunity must not be passed over of expressing the debt of gratitude that the inhabitants of Perth in general, and we as naturalists in particular, owe to the proprietors of the hill, and especially to the Earl of Kinnoull, for the privilege of more or less free access to it.

*Note,*—Since it might be objected that by publishing the localities of the rarer plants and animals of Kinnoull Hill, the danger of their extermination by unscrupulous persons might be incurred, it may be mentioned that in any instance where this is at all likely to be the case, Kinnoull Hill is *already* known as a locality, and hence no harm can be done by republication.

## II.—The Geology.

By Professor James Geikie, LL.D., F.R.S.

Kinnoull Hill, with Caller Fountain Hill and Moncreiffe Hill, may be said to form the south-west termination of the Sidlaws. The Sidlaws, however, are only a subordinate portion of that long belt of high ground, which, with several interruptions, extends from the coast-lands near Stonehaven south-west across the whole breadth of Scotland to the shores of the Firth of Clyde at Ardrossan. This belt of high grounds I have elsewhere designated as the Northern Heights of the Lowlands. A long narrow depression separates these heights from the Highlands—a depression which reaches its greatest width in Strathmore.

Kinnoull Hill, which is 728 feet above the sea-level, presents a steep escarpment to the south,—the upper 200 feet forming a cliff which slopes at an angle of 60 degs. Below this the angle of slope is less,—the average for the succeeding 300 feet being about 46 degs.,—from which, down to the alluvial plain of the Tay, the inclination is very little more than 20 degs. Towards the north the hill falls away with a comparatively gentle slope, the average inclination from the top of the hill to the road near Muirhall Toll-bar being hardly more than 7 degs., or 1 in 8. Towards the west the declivity is steeper,—the average inclination from the summit to the road at Barnhill being about 10 degs., or 1 in 6. Going towards north-east, we find, as already observed, that Kinnoull Hill forms a portion of that well-marked belt of high ground, the Sidlaw Hills.

### PETROLOGY OF KINNOULL HILL.

The rocks which enter into the composition of Kinnoull Hill show no great variety. There are representatives of the two chief classes, viz., Crystalline and Fragmental,—the former consisting of igneous and the latter of aqueous and aqueo-igneous rocks.

1. *Crystalline Rocks.*—These are chiefly *porphyrites*, but augitic rocks (basalt, diabase, &c.) are also met with. Porphyrites form nearly the whole surface of Kinnoull Hill,—the most prominent variety being a dark purplish blue rock, with a fine-grained base, scattered through which are conspicuous crystals of plagioclase. In some places the rock is highly vesicular and amygdaloidal—the amygdules consisting as usual of calcite, green earth, quartz, calcedony, jasper, &c. Under the microscope these fine-grained rocks show a finely crystalline ground-mass composed of small rod-like crystals of plagioclase and granules of pyroxene, mica, magnetite, or ilmenite. Scattered through this ground-mass occur larger crystals of plagioclase, often accompanied by hornblende, augite, or mica. Traces of a glassy or devitrified base are occasionally met with. Very few of the porphyrites do not show traces of alteration. Usually the basic silicates are more or less altered, and replaced by secondary or decomposition products. These porphyrites occur in broad sheets, which vary much in thickness—50 or 60 feet being a common thickness for individual beds: occasionally, however, they are thicker, and not infrequently they do not exceed 12 to 15 feet in thickness. The upper and lower portions of each bed are generally more or less vesicular, as is common in modern lava-flows. These and other pheuomena are well exposed in the great cliff, but they may also be studied all over the surface of the hill wherever the rock is sufficiently exposed; but as all the porphyrites are more or less weathered and crumbling, it is hard to get typical specimens showing the

characters referred to. Diabase and melaphyre occur near Kingswells, above Kinfauns. These rocks are simply altered basalt rocks. They consist essentially of plagioclase, augite, and olivine with magnetite: but the olivine usually is serpentinized and the augite also is generally more or less altered. A well-marked basalt-rock has long been quarried on the slopes at Corsiehill.

These are the chief kinds of crystalline igneous rock met with in the hill itself. It is sometimes hard to say whether some of the fine-grained blue rocks should be classed with the porphyrites or the basalt-rocks; but although they sometimes closely approach the latter in character they seem to be most nearly related to the porphyrites, and to belong to the great class of andesitic lavas.

2. *Fragmental Rocks.*—These consist of conglomerate, grit, sandstone, tuff, breccia, and tuffaceous grits, &c. The conglomerates are made up of somewhat well-rounded stones, consisting of various porphyrites, commingled with which are fragments of quartzite, felsite, &c.—the whole being set in a matrix of comminuted felspathic matter. Sometimes the stones are arranged in well-marked layers: in other places little or no trace of bedding is visible. Such conglomerate passes laterally into coarse grit, and this shades off into sandstone, with which dull argillaceous shales are now and again associated. All these beds are evidently of aqueous origin: they have been derived from the degradation of the crystalline and fragmental igneous rocks with which they are interbedded. Frequently, however, the aqueous rocks now described seem to shade off laterally into rocks which have all the appearance of true tuffs. The rocks referred to consist of rudely-bedded masses, consisting of angular and subangular stones set in a matrix or ground-mass of comminuted porphyrite. The stones have all the appearance of *lapilli*, and have been derived from the immediate neighbourhood. They are, in short, bits of porphyrites. These tuffs vary in colour—dull yellow, green, brown, red, and grey shades being common. They are best seen in the grounds of Kinfauns, where they are closely associated with conglomerate. [A much better locality for their study, however, is the slope of Friarton Hill, at and above the railway.]

All the rocks now described, with the exception of the basalt of Corsiehill Quarry, belong to the Lower Old Red Sandstone formation; and it now remains to describe briefly the geological structure of the ground. The structure could hardly be simpler. Kinnoull Hill is, in short, composed of a succession of bedded porphyrites and interbedded fragmental rocks, all of which dip gently towards north-west.

The upper 600 feet of the hill consist chiefly of porphyrites, which are occasionally separated by thin beds of fragmental rocks—one very good example of which may be studied near the Dragon's Hole and in the cliff-face above Lairwell. Here may be seen a bed of conglomerate of rounded stones, some of which are about 2 feet in diameter. This conglomerate rests upon the scoriaceous upper surface of a porphyrite, and is overlaid by another bed of porphyrite—the bottom portion of which is likewise scoriaceous, and in places abundantly charged with baked sandstone and mudstone. A very good section showing some of the interbedded sandstones and shales was exposed in Witchhill Quarry, which is now occupied by the Board School. The section is still partly exposed behind the school.

To the overlying porphyrites, which form the upper portion, and indeed nearly all the surface of Kinnoull Hill, succeed thick conglomerates and tuffaceous beds which crop out underneath the great cliff. How thick these conglomerate beds are it is difficult to say. But they are probably not less than 250 or 300 feet. They may be followed along the base of the great cliff to Kinfauns, and up the Deuchney Burn to near the saw-mills. Behind the Home-Farm they contain at least one intercalated sheet of porphyrite. It may be as well to note here that the tuffaceous beds which crop out in the railway cutting at the tunnel, near Nether Friarton, are on the same horizon as the conglomerates of Kinnoull and Kinfauns. On the slopes of the Friarton Hill they are well exposed, and alternate in that neighbourhood with beds of porphyrite; and possibly the same may be the case to some extent with the conglomerates underlying the porphyrites of the great cliff of Kinnoull: for in that neighbourhood the falls of debris hide the lower part of the section.

It is obvious from the dip of the strata that the Kinnoull conglomerates must be underlaid by porphyrite. The rocks forming Moncreiffe Hill are inclined towards the north-west and north, and without doubt continue across the Tay so as to underlie Kinnoull Hill. Taking the average inclination of the rocks at 8 deg., or 1 in 7, we get the following thicknesses for the igneous and associated fragmental rocks of the hill:—

| | |
|---|---|
| Upper porphyrites with interbedded sandstones and conglomerates,.............. | 600 feet. |
| Conglomerate, tuffs, breccias, &c., lying at base of hill,.............................. | 250 ,, |
| Lower porphyrites (seen in Moncreiffe Hill), | 800 ,, |
| | 1650 feet. |

HISTORICAL GEOLOGY OF KINNOULL HILL.

It is impossible to read off the geological history of Kinnoull Hill without reference to the range of which it forms only an insignificant part. I shall therefore simply state that an examination of the whole range leads to the belief that the porphyrites were erupted upon the floor of a large inland sea or lake, the northern shores of which were formed by the rocks of the Highland area. Over the floor of that ancient lake were deposited the red sandstone of Strathmore, and the flags and shales with which the porphyrites are in many places interbedded. The igneous rocks seem in time to have formed low volcanic banks or hills rising above the level of the lake, in the waters of which the fragmental materials ejected from the old volcanic foci were winnowed and spread out in bedded layers. The coarse conglomerates seem in many places to indicate the action of torrential water. Probably the volcanic hills were subject here and there to the denuding action of streams and torrents which rolled the fragmental materials down into the lake, where they formed broad cone-like sheets. The general distribution of the conglomerates and their very irregular appearance—thickening and thinning out as

they do, and passing laterally into beds of grit and tuffaceous grit and saudstone—all betoken some such mode of formation. In many places it is obvious that the porphyrites flowed over the bed of the lake, for they have often caught up much of the sediment, which we now find involved in their lower portions in the form of baked and hardened sandstone, conglomerate, and mudstone. Obscure plant-markings and vegetable debris seem to indicate that the slopes of the volcanic hills may now and then have supported a cryptogamic flora. The only relics of intrusive igneous rocks belonging to the same period are the irregular bosses and masses of diabase which occur in the neighbourhood of Kinfanns. These are of the same general character as the rocks which occupy what appear to have been the deeper seated portions of the old volcanic foci, aud which are well seen at Balgay Hill and elsewhere in the Dundee district. At Kinfauns the diabase seems to occur as irregular dyke-like masses and irregular sheets ; but in all probability they belong to the later stages of the volcanic period. They were certainly not erupted at the surface, but are now exposed simply because the rocks which formerly covered them have been removed by denudation.

*Faults.*—Very few faults or dislocations are noticeable in the hill. The best-marked are two which may be seen in the cliff above Lairwell. Neither, however, is of much importance. They are seen cutting across the bed of conglomerate already referred to.

TERTIARY DYKE.

In Corsiehill quarry a very good example is seen of a dyke, which, like the dykes of the same character in many other parts of Scotland, probably belongs to Tertiary times. It is a dark blue crystalline basalt-rock—crypto-crystalline and fine grained at the sides, but more coarsely crystalline towards the centre: where also it is sparingly vesicular. Areas of small vesicles may also be seen in the rock near the sides of the dyke. The junction between it and the porphyrite is somewhat irregular, and is well worthy of study. The dyke varies a little in width, but 30 feet is perhaps a good average. It is jointed, as usual, at right angles to the cooling planes.

GLACIAL PHENOMENA.

Kinnoull Hill has been overflowed by ice. This is shown by the manner in which the rocks are bevelled off. Owing to the crumbling of the porphyrites, however, glacial striæ have seldom been preserved. They may be seen at various places on or near the hill, as at Muirhall quarry, in the fields above Limepotts, at Deuchny quarry, at Corsiehill, &c. (It may be noted that they are very plentifully distributed all over the hill-slopes between the top of Moncreiffe Hill, and the road leading to Rhynd.) The striæ on Kinnoull Hill vary in direction with the form of the hill. At Muirhall, for example, they point S. 45 degs. E., while at Corsiehill they are deflected more to the east. The general direction of glaciation may be taken as from north-west to south-east.

Boulder-clay, generally reddish in colour, occurs in patches here and there over the hill—the stones in the clay consisting mostly of porphyrites; but commingled with these are fragments of the red and grey saudstones of Strathmore and some fragments of Highland rocks.

## III.—The Flowering Plants.

By Mr James Coates.

In taking a ramble of botanical discovery over Kinnoull Hill, I cannot promise any finds of a very remarkable nature. The locality under consideration is no Ben Lawers, or Sow of Athole, famed for its rare collection, or noted as a unique locality. Still, much may be found which will reward a diligent search, and even some specialities quite worthy of the few minutes' attention I shall devote to them.

Within the geographical limits prescribed for our paper, the phanerogams, or flowering plants, are represented by about 350 species native to our island. Of these, however, about 40 have become naturalised, but are not indigenous to this locality, while a few, which are known to have existed formerly, have since become extinct. The comparatively large proportion of plants which have become naturalised, may be accounted for by the fact that from the nature and position of Kinnoull Hill, it is favourably situated for this process. In its immediate neighbourhood a populous centre has been situated for centuries, where the inhabitants, at least in the outskirts, must have constantly carried on the practice of cultivation. The hill stands at just such a distance from those suburban gardens that seeds could be conveniently carried by wind, or birds, or other agencies. These seeds, having once found a resting-place on the steep slopes or rock crevices, might easily escape disturbance, owing to the ground being difficult of access, and would thus become established so as to claim for themselves at last the natural possession of the soil. Thus it is that on and around the cliffs we shall find a considerable number of the more delicate of the naturalised plants, although many have also succeeded in establishing themselves in apparently less favourable situations.

For convenience, I shall notice first the little group of forest trees, although such a classification, separating them from the other flowering plants, is altogether arbitrary.

The wooding is chiefly confined to the northern slope of the hill, and to the ground which shelves steeply away from the base of the cliffs on the southern face until it meets the level plain. Of the trees composing these woods a large number, such as the spruces and larches, are mere introductions from other countries, and although they have now obtained a firm footing in Britain, they are not more entitled to be included, even among the naturalised flora of Kinnoull Hill, than are the laburnums, the scarlet geraniums, and other exotics which ornament the villa gardens on its slopes. Of others, again, which are true natives of

Scotland, it is not always easy to determine whether they are indigenous to the spot on which they are growing. So many trees are cultivated for commercial and ornamental purposes that one is often baffled in attempting to limit the number artificially planted. The difficulty is increased in the present instance by the fact, already referred to, of Kinnoull Hill having been denuded at one time of its forests, and replanted a little over a century ago. It is scarcely credible that the destruction could have been so sweeping but that here and there, in sheltered spots, a single tree or a stray group would remain to mark more strongly the desolation by its loneliness. We may at least conjecture that a few seeds or runners would be left in the ground, which would afterwards germinate and spring up to represent a natural and primeval growth.

But making allowance for these doubts, we may include in our list of the tree-flora about 12 genera native to Perthshire, as being either indigenous or naturalised on Kinnoull Hill. These are:—mountain ash, hawthorn, elder, ash, elm, alder, birch, oak, hazel, crab apple, willow, juniper, pine. If we count species, this number will be considerably increased, as of the willows alone there are at least ten species, and possibly more. The tendency to variation among the willows exhibits in a marked manner the phenomena of evolution, and makes this family a very difficult one to determine with accuracy. The work of identification is, however, still in progress. Three species of willow are worthy of special mention on account of their rarity—*Salix pentandra*, *S. Smithiana*, and *S. phylicifolia*. All of these are found below Barnhill, near the river-bank. The first is represented by only a few plants, which may, perhaps, have been planted. The mention of the juniper is interesting from the fact that there is but one solitary bush to entitle it to a place on this list. It grows in the woods above Corsiehill. The crab apple, to which I have referred, is the variety *mitis* of the ordinary *Pyrus malus*. This is certainly introduced, as var. *acerba* is the only one found wild in Scotland.

Coming now to the smaller flowering plants, we have an ample variety to occupy our attention. We shall probably find most of our well-known friends (although one—the wood anemone—is, strange to say, conspicuous by its absence), and also a few with which we are less familiar. Kinnoull Hill proper is comparatively dry. It can boast of neither pond nor stream, and its water-courses are represented but by insignificant springs. As a consequence, we find an almost complete absence of water plants, until we come down to the river-bank, and this fact has also much to do in determining the general appearance of the vegetation. Thus the cliffs do not present to us that rich tangle of verdure which we are accustomed to in so many Highland glens, because there is not the constant trickle from above which supplies the necessary moisture. But these conditions are not essential to the existence of all plants, and the number of different species on and around these dry cliffs makes amends for the absence of luxuriance in a few.

Let us suppose ourselves standing on the top of the cliffs just beside the tower. When we have fully admired the beauty of the view, we shall have leisure to look about for floral beauties. Our attention will probably first be attracted by the pale sulphur yellow blossoms of the Rock Rose (*Helianthemum vulgare*), growing on the very brink of the precipice. We can also perceive down below, if we look over, another plant with flowers of a stronger yellow tint clinging to cracks in the face of the rock where it would scarcely seem possible that sufficient soil could collect. If we now descend through one of the wooded gullies which at several points interrupt the cliff, we shall doubtless, with a little trouble, be able to secure a specimen within reach. We are thus able to identify the specimen as *Cheiranthus Cheiri*, or Wild Wallflower. This is a naturalised plant, and one which spreads readily from cultivation, and easily adapts itself to such situations as that in which we have just found it. It is worthy of note that the flowers are entirely yellow, and not red or striped with red as in the garden varieties we are now accustomed to. Searching along the upper edges and base of the cliffs, if we are a little adventurous, and do not mind a few scratches from thorns and projecting rock-edges, numbers of other "finds" will reward us. I shall just mention a very few of the more interesting.

*Arabis hirsuta* (Hairy Rockcress) is not at all abundant in Britain, and found only very locally in Scotland.

*Cerastium tetrandrum* is interesting on account of the locality being an inland one, this plant being almost always found near the sea.

*Sagina subulata*, a rather local Pearlwort.

*Geranium lucidum*, a local plant, although not uncommon.

*Astragalus hypoglottis*, *Vicia angustifolia*, and *V. lathyroides*. These three are members of the pea-flower tribe, none of them being frequently met with. They are found growing along the upper edges of the cliffs, between the "pulpit" and the stone table.

*Potentilla argentea* (Hoary Potentil), so called on account of the close white down covering the under side of the leaves and stems.

*Conium maculatum*. This is the true Hemlock, and not

at all so common as is often supposed, as the name is given indiscriminately to other members of the same family which much resemble it, the form and appearance of the flowers of the Umbelliferae being generally very similar. Another example, for instance, is

*Chærophyllum Anthriscus*, a still more scarce plant in Scotland, but which here grows on the edge of the cliff between the stone table and the "pulpit."

*Valerianella olitoria*, or Common Corn Salad, also on the edge of the cliffs. As its name would imply, it is said to make an excellent substitute for the garden lettuce.

*Dipsacus sylvestris*, or Teasel. This singular plant, with its prickly stems, which attain sometimes to a height of four or five feet, is very rare in Scotland, although common enough in the south of England, and it is difficult to say how it found its way to this locality.

*Lactuca virosa*, a near relative of the lettuce of our kitchen gardens, although wanting its succulent qualities. This plant may be considered a feature of Kinnoull Hill, because in Scotland it is rare, and, so far as I am aware, has not been recorded from further north than Perthshire.

*Verbascum Thapsus* and *Echium vulgare*. These two showy plants, with their tall handsome rods,—the one of bright yellow, the other of blue flowers,—would probably before now, but for their secluded position, have fallen a prey to the transplanter.

*Antirrhinum majus*, better known by its common name, "Snapdragon." This is another of the naturalised relics of cultivation, and is fast becoming very scarce.

*Origanum vulgare*, Wild Marjoram, related to the Sweet Marjoram of our gardens. Rare in Scotland.

*Myosotis collina*, a small low-growing member of the Forget-me-not family.

*Allium vineale*, Crow Garlic, sparingly found on the cliffs.

*Hesperis matronalis*. This plant is found growing freely, although in a naturalised state, on the debris at the foot of the cliffs, as also on Moncreiffe Hill. This is a very noteworthy fact, as it contradicts the opinions of some of the most eminent botanical authorities. For instance, Hooker, in the first edition of his *Students' Flora*, describes it as being "an escape, not even naturalised," although in the third edition he somewhat modifies this by saying, "rarely if ever naturalised." Bentham describes it as "probably only an outcast from gardens."

*Agrimonia Eupatoria*, Agrimony. Although apparently now extinct, it is recorded as far back as 1774 in Cant's edition of Adamson's "Muses Threnodie." The editor says in a note, "There are several officinal plants to be found on the face of Kinnoull Hill, among which are Agrimony."

In the neighbourhood of the "pulpit" a group of plants may be examined. The first of these and the best is

*Viola hirta*, Hairy Violet. This may readily be distinguished from the common Wood Violet, by its much larger and broader leaves. In fact it approaches much nearer to, and is sometimes considered a mere variety of, the Sweet Violet. A little way off under a hedge are two plants—

*Sanicula europaea* and *Asperula odorata*. The Woody Sanicle is common enough in the Highlands, but less so in the Lowlands. The other plant, better known by its popular name "Woodruff," is interesting chiefly because being usually abundant in similar localities it is here confined to but an insignificant patch.

In the woods proper, not much of special interest is to be found, but mention must be made of

*Vaccinium Vitis-Idaea*, or Cowberry, well known to the frequenter of the heather-clad mountains, but seldom met with in such localities as this.

*Linnæa borealis* is recorded in Hooker's *Flora Scotica* as occurring on the "Hill of Kinnoull, near Perth," in 1821, but it must now have become quite extinct.

*Vinca minor*, the Periwinkle, and *Ligustrum vulgare*, the Privet. I mention these two plants merely to warn against the possible notion that they are wild, both of them having been planted for ornamental purposes.

*Solanum Dulcamara*, the Woody Nightshade. A scarce plant in Scotland. It used to grow sparingly near the top of the hill, but I am doubtful of its being still there.

Leaving the woods, we may continue our search among the fields and hedgerows, and along the roadsides, and a new set of plants will probably reward us. In the fields which clothe the slopes above Barnhill we shall come across

*Ranunculus hirsutus*, Hairy Ranunculus. An uncommon plant in Scotland.

*Lepidium campestre*, Field Cress. Scarce in Perthshire.

*Daucus carota*, Wild Carrot. This plant is commonly found near the sea-shore, but is of much less frequent occurrence inland. The well-known thick fleshy root of the garden carrot is in the wild specimen represented only by a thin and slender one, which need by no means be hunted for its edible properties.

*Veronica Buxbaumii*. Rare in this district.

Also in the Barnhill neighbourhood we shall find

*Senecio Doria*. This member of the Groundsel family is not includsd in the British flora, and therefore can only be allowed here as a relic of cultivation.

*Cynoglossum montanum*, Green Houndstongue. In a thicket on the steep railway bank below the road just

beyond Barnhill. The plant, as well as the situation in which it grows, is a conspicuous one, and it is to be hoped that it will not on that account be subjected to rough treatment. It is described by Hooker as being found not further north than Essex, except about Perth and Forfar, where it has become naturalised; and it is, therefore, well worthy of careful preservation, and a better fate than

*Saponaria officinalis*, another naturalised plant recorded from near the same spot but probably now extinct.

*Lythrum salicaria*, Purple Loosestrife, may be found near the Dundee ticket platform, but only as an escape from cultivation.

On the site now occupied by Kinnoull School two interesting plants formerly grew, but of course have now been completely extirpated. These were

*Poterium muricatum* (erroneously recorded as the much commoner species, *P. sanguisorba*), and

*Potentilla hirta*.

*Convolvulus arvensis*, with its delicate pink flowers and arrow-shaped leaves, may be found trailing along the side of the road leading past Kinnoull Manse.

*Cynoglossum officinale*, Common Houndstongue, is mentioned by Lightfoot in the *Flora Scotica* published in 1792, as occurring at the "foot of Kinnoull Hill," and is common enough below the cliffs.

Another plant recorded by Wynch, of Northumberland, in 1820, as also from the "foot of Kinnoull Hill," is *Geranium Pyrenaicum*. Until very lately this plant has been known to exist on the side of the road leading to Fairmount, and may still be found in the hedges on the Muirhall Road.

A few so-called weeds of cultivation may be here briefly mentioned as occurring either in the Perth Nurseries or in private gardens.

*Veronica peregrina*, common in the Nurseries.

*Veronica polita*. It has probably been formerly passed over as the common *V. agrestis*.

*Sagina apetala* and *Sagina ciliata*, two species of Pearlwort growing together in gravel walks. The latter is said to have once grown underneath the Stone Table.

*Anagallis caerulea*, Blue Pimpernel, and

*Plantago media*, Hoary Plantain.

I shall conclude this survey of the more special plants of Kinnoull Hill by mentioning a very few more which grow either in the river or close beside it. Commencing at our northern limit, we find below Perth Bridge,

*Potamogeton nitens*. This spot has the distinction of being one of the five original localities in the United Kingdom in which until quite recently this rare pond weed was only known to exist, and the honour of its discovery there belongs to one of the oldest members of our Society, Mr John Sim, of Bridgend.

*Rumex alpinus*, Alpine Dock, used to grow on the river wall just below the bridge, and may still exist there. It is, however, only a naturalised plant, having been cultivated for the medicinal properties of its root.

*Carex muricata* is found beside Kinnoull Churchyard; and another sedge,

*Carex remota*, in a ditch near the old toll-bar.

Some good finds may be obtained on the riverbank below the Nurseries, including

*Hypericum dubium*, Unperforated St John's Wort.

*Petasites alba*, which, although excluded from our flora, has been here naturalized; and these remarks apply also to another species,

*Petasites fragrans*, on the road leading to Fairmount.

The last species I shall name as having occurred beside the Nurseries is

*Mentha sylvestris*, the rare Horse Mint; but unfortunately it can only be named as a thing of the past, as in this situation it is no longer to be gathered.

After passing Barnhill we come upon a curious feature, for, if we examine what for a considerable distance appears to be merely a grassy bank, we shall find it really composed of

*Allium oleraceum*, or Field Garlic. Its grassy appearance and manner of growth might readily cause it to be overlooked by the unobservant, but once the perfume of its leaves is felt, it can no longer be mistaken. Lastly, I would mention a rare variety of the common Mouse-ear Chickweed,

*Cerastium triviale* v. *holosteoides*. Hooker mentions Perth as one of the few localities in Britain where this variety occurs, and, curiously enough, within tidemarks it is abundant, and quite takes the place of the common form on both sides of the river. Back from the river the ordinary roadside weed again asserts itself as usual.

I think I have now said enough to show that Kinnoull Hill is not without interest as a botanical field, at least to those who are wise enough to seek out the interest it presents.

For much of the information as to the localities of the plants I am indebted to Dr Buchanan White.

# LIST OF FLOWERING PLANTS.

## A. SPECIES PROBABLY INDIGENOUS.

RANUNCULUS.
peltatus, Fries.
hederaceus, Linn.
Flammula, Linn.
acris, Linn.
repens, Linn.
bulbosus, Linn.
hirsutus, Curtis.
Ficaria, Linn.

CALTHA.
palustris, Linn.

PAPAVER.
Rhœas, Linn.
dubium, Linn.

FUMARIA.
pallidiflora, Jord.
var. Boræi.
officinalis, Linn.

RAPHANUS.
Raphanistrum, Linn.

SINAPIS.
arvensis, Linn.

SISYMBRIUM.
officinale, Scop.
Alliaria, Scop.

CARDAMINE.
pratensis, Linn.
hirsuta, Linn.
sylvatica, Link.

ARABIS.
thaliana, Linn.
hirsuta, Brown.

BARBAREA.
vulgaris, Brown.

NASTURTIUM.
officinale, Brown.

DRABA.
verna, Linn.

CAPSELLA.
Bursa-pastoris, Mœnch.

LEPIDIUM.
campestre, Brown.

RESEDA.
Luteola, Linn.

HELIANTHEMUM.
vulgare, Gaert.

VIOLA.
palustris, Linn.
hirta, Linn.
sylvatica, Fries.
tricolor, Linn.

POLYGALA.
depressa, Wender.

LYCHNIS.
vespertina, Sibth.
Flos-cuculi, Linn.

CERASTIUM.
tetrandrum, Curt.
semidecandrum, Linn.
glomeratum, Thuil.
triviale, Link.
var. holosteoides.

STELLARIA.
media, With.
Holostea, Linn.
graminea, Linn.
uliginosa, Murr.

ARENARIA.
trinervis, Linn.
serpyllifolia, Linn.

SAGINA.
apetala, Linn.
ciliata, Fries.
procumbens, Linn.
subulata, Wimm.

SPERGULA.
arvensis, Linn.

SPERGULARIA.
rubra, Fenzl.

SCLERANTHUS.
annuus, Linn.

HYPERICUM.
perforatum, Linn.
pulchrum, Linn.

LINUM.
catharticum, Linn.

GERANIUM.
sanguineum, Linn.
pratense, Linn.

(GERANIUM.)
molle, Linn.
dissectum, Linn.
lucidum, Linn.
Robertianum, Linn.

ERODIUM.
cicutarium, Herit.

ULEX.
europæus, Linn.

SAROTHAMNUS.
scoparius, Koch.

MEDICAGO.
lupulina, Linn.

TRIFOLIUM.
pratense, Linn.
repens, Linn.
procumbens, Linn.
minus, Sm.

LOTUS.
corniculatus, Linn.
major, Scop.

ASTRAGALUS.
hypoglottis, Linn.

VICIA.
hirsuta, Koch.
Cracca, Linn.
sepium, Linn.
angustifolia, Roth.
lathyroides, Linn.

LATHYRUS.
pratensis, Linn.

OROBUS.
tuberosus, Linn.

PRUNUS.
spinosa, Linn.

SPIRÆA.
Ulmaria, Linn.

ALCHEMILLA.
arvensis, Scop.
vulgaris, Linn.

POTENTILLA.
Fragariastrum, Ehrh.
Tormentilla, Schenk.
anserina, Linn.
argentea, Linn.

FRAGARIA.
vesca, Linn.

RUBUS.
Idæus, Linn.
corylifolius, Sm.
Radula, Weihe.
humifusus, Weihe. (?)

GEUM.
urbanum, Linn.
rivale, Linn.

ROSA.
spinosissima, Linn.
tomentosa, Sm.
canina, Linn.
var. lutetiana.
,, sphærica.
,, dumalis.
,, urbica.
,, Reuteri.
,, subcristata.
,, coriifolia.
,, Watsoni.
mollissima, Willd.

CRATÆGUS.
Oxyacantha, Linn.

PYRUS.
Aucuparia, Gaert.

EPILOBIUM.
montanum, Linn.
obscurum, Schreb.

MYRIOPHYLLUM.
alterniflorum, DC.

CALLITRICHE.
verna, Linn.

SEDUM.
Telephium, Linn.
acre, Linn.

SAXIFRAGA.
granulata, Linn.

SANICULA.
europæa, Linn.

ÆGOPODIUM.
Podagraria, Linn.

BUNIUM.
flexuosum, With.

PIMPINELLA.
Saxifraga, Linn.

ŒNANTHE.
crocata, Linn.

ÆTHUSA.
Cynapium, Linn.

ANGELICA.
sylvestris, Linn.

HERACLEUM.
Sphondylium, Linn.

DAUCUS.
Carota, Linn.

TORILIS.
Anthriscus, Gaert.

CHÆROPHYLLUM.
Anthriscus, Lam.
sylvestre, Linn.
temulum, Linn.

CONIUM.
maculatum, Linn.

HEDERA.
Helix, Linn.

LONICERA.
Periclymenum, Linn.

GALIUM.
boreale, Linn.
cruciatum, With.
verum, Linn.
saxatile, Linn.
palustre, Linn.
Aparine, Linn.

ASPERULA.
odorata, Linn.

SHERARDIA.
arvensis, Linn.

VALERIANA.
officinalis, Linn.

VALERIANELLA.
olitoria, Moench.

DIPSACUS.
sylvestris, Linn.

SCABIOSA.
succisa, Linn.
arvensis, Linn.

CARDUUS.
crispus, Linn.
lanceolatus, Linn.
palustris, Linn.
arvensis, Curt.

ARCTIUM.
minus, Schkuhr.
nemorosum, Lej.

CENTAUREA.
nigra, Linn.

CHRYSANTHEMUM.
segetum, Linn.
Leucanthemum, Linn.

MATRICARIA.
inodora, Linn.

TANACETUM.
vulgare, Linn.

ACHILLEA.
Millefolium, Linn.

FILAGO.
germanica, Linn.

GNAPHALIUM.
uliginosum, Linn.

SENECIO.
vulgaris, Linn.
Jacobæa, Linn.
aquaticus, Huds.

BELLIS.
perennis, Linn.

TUSSILAGO.
Farfara, Linn.

LAPSANA.
communis, Linn.

HYPOCHŒRIS.
radicata, Linn.

LEONTODON.
autumnalis, Linn.

TARAXACUM.
officinale, Wigg.
var. erythrospermum.

LACTUCA.
virosa, Linn.

SONCHUS.
oleraceus, Linn.
arvensis, Linn.

CREPIS.
virens, Linn.
paludosa, Moench.

HIERACIUM.
Pilosella, Linn.
vulgatum, Fries.

CAMPANULA.
rotundifolia, Linn.

VACCINIUM.
Vitis-Idæa, Linn.
Myrtillus, Linn.

ERICA.
cinerea, Linn.

CALLUNA.
vulgaris, Salisb.

PYROLA.
minor, Linn.

FRAXINUS.
excelsior, Linn.

CONVOLVULUS.
arvensis, Linn.

VERBASCUM.
Thapsus, Linn.

SCROPHULARIA.
nodosa, Linn.

DIGITALIS.
purpurea, Linn.

VERONICA.
hederifolia, Linn.
polita, Fries.
agrestis, Linn.
arvensis, Linn.
serpyllifolia, Linn.
officinalis, Linn.
Chamædrys, Linn.
Beccabunga, Linn.

EUPHRASIA.
officinalis, Linn.

RHINANTHUS.
Crista-galli, Linn.

MENTHA.
arvensis, Linn.

THYMUS.
Serpyllum, Fries.

ORIGANUM.
vulgare, Linn.

NEPETA.
Glechoma, Benth.

PRUNELLA.
vulgaris, Linn.

STACHYS.
palustris, Linn.

GALEOPSIS.
Tetrahit, Linn.

LAMIUM.
amplexicaule, Linn.
purpureum, Linn.
album, Linn.

TEUCRIUM.
Scorodonia, Linn.

ECHIUM.
vulgare, Linn.

MYOSOTIS.
palustris, With.
arvensis, Hoffm.
var. umbrosa.
collina, Reich.

ANCHUSA.
arvensis, Bieb.

CYNOGLOSSUM.
officinale, Linn.
montanum, Lam.

PRIMULA.
vulgaris, Huds.

ANAGALLIS.
arvensis, Linn.

PLANTAGO.
major, Linn.
lanceolata, Linn.

LITTORELLA.
lacustris, Linn.

CHENOPODIUM.
album, Linn.

ATRIPLEX.
angustifolia, Sm.

RUMEX.
obtusifolius, Auct.
Acetosa, Linn.
Acetosella, Linn.

POLYGONUM.
aviculare, Linn.
Persicaria, Linn.
amphibium, Linn.

EUPHORBIA.
Helioscopia, Linn.
Peplus, Linn.

MERCURIALIS.
perennis, Linn.

URTICA.
dioica, Linn.
urens, Linn.

ULMUS.
montana, Sm.

QUERCUS.
Robur, Linn.

CORYLUS.
Avellana, Linn.

ALNUS.
glutinosa, Linn.

BETULA.
alba, Linn.

SALIX.
fragilis, Linn.
alba, Linn.
purpurea, Linn.
viminalis, Linn.
Smithiana, Willd.
cinerea, Linn.
aurita, Linn.
var. nemorosa cinerascens.
Caprea, Linn.
var. latifolia subcordata.
,, parvifolia.
phylicifolia, Linn.

JUNIPERUS.
communis, Linn.

POTAMOGETON.
nitens, Web.

ORCHIS.
mascula, Linn.
maculata, Linn.

LISTERA.
ovata, Brown.

ALLIUM.
vineale, Linn.

LUZULA.
campestris, DC.
multiflora, Koch.

JUNCUS.
effusus, Linn.
acutiflorus, Ehrh.

CAREX.
pulicaris, Linn.
muricata, Linn.
stellulata, Good.
remota, Linn.
vulgaris, Fries.
glauca, Scop.
præcox, Jacq.
panicea, Linn.

ANTHOXANTHUM.
odoratum, Linn.

DIGRAPHIS.
arundinacea, Trin.

ALOPECURUS.
geniculatus, Linn.
pratensis, Linn.

PHLEUM.
pratense, Linn.

AGROSTIS.
canina, Linn.
vulgaris, With.

AIRA.
cæspitosa, Linn.
flexuosa, Linn.
caryophyllea, Linn.

AVENA.
pratensis, Linn.

HOLCUS.
mollis, Linn.
lanatus, Linn.

KOELERIA.
cristata, Pers.

GLYCERIA.
fluitans, Brown.

POA.
annua, Linn.
nemoralis, Linn.
pratensis, Linn.
trivialis, Linn.

CYNOSURUS.
cristatus, Linn.

DACTYLIS.
glomerata, Linn.

FESTUCA.
ovina, Linn.

BROMUS.
sterilis, Linn.
commutatus, Schrad.
mollis, Linn.

BRACHYPODIUM.
sylvaticum, R. and S.

TRITICUM.
caninum, Huds.
repens, Linn.

LOLIUM.
perenne, Linn.
italicum, Braun.

## B. SPECIES MORE OR LESS NATURALISED.

BERBERIS.
vulgaris, Linn.

CHELIDONIUM.
majus, Linn.

BRASSICA.
napus, Linn.

HESPERIS.
matronalis, Linn.

CHEIRANTHUS.
Cheiri, Linn.

GERANIUM.
pyrenaicum, Linn.

ACER.
Pseudo-platanus, Linn.

TRIFOLIUM.
incarnatum, Linn.

PRUNUS.
insititia, Linn.
Avium, Linn.

RUBUS.
laciniatus.

ROSA.
rubiginosa, Linn.

PYRUS.
Malus, Linn.
var. mitis.

LYTHRUM.
Salicaria, Linn.

RIBES.
Grossularia, Linn.

SEDUM.
album, Linn.
reflexum, Linn.

SAXIFRAGA.
umbrosa, Linn.

ASTRANTIA.
major, Linn.

SAMBUCUS.
nigra, Linn.

MATRICARIA.
Parthenium, Linn.

GNAPHALIUM.
margaritaceum, Linn.

DORONICUM.
Pardalianches, Linn.

CAMPANULA.
rapunculoides, Linn.

LIGUSTRUM.
vulgare, Linn.

VINCA.
minor, Linn.

SCROPHULARIA.
vernalis, Linn.

ANTIRRHINUM.
majus, Linn.

LINARIA.
repens, Mill.

MIMULUS.
luteus, Linn.

VERONICA.
Buxbaumii, Ten.
peregrina.

SYMPHYTUM.
tuberosum, Linn.

ANAGALLIS.
cærulea, Sm.

PLANTAGO.
media, Linn.

CHENOPODIUM.
B. Henricus, Linn.

RUMEX.
alpinus, Linn.

SALIX.
pentandra, Linn.

ELODIA.
canadensis, Mich.

ALLIUM.
oleraceum, Linn.

AVENA.
flavescens, Linn.

BRIZA.
media, Linn.

## C. SPECIES EXTINCT, OR VERY DOUBTFUL.

SAPONARIA.
officinalis, Linn.

HYPERICUM.
dubium, Leers.

MALVA.
sylvestris, Linn.

GERANIUM.
Phæum, Linn.

AGRIMONIA.
Eupatoria, Linn.

POTERIUM.
muricatum, Spach.

LINNÆA.
borealis, Gronov.

INULA.
Helenium, Linn.
Conyza, DC.

SOLANUM.
Dulcamara, Linn.

VERBASCUM.
nigrum, Linn.

LINARIA.
Cymbalaria, Mill.

MENTHA.
sylvestris, Linn.

EUPHORBIA.
Lathyris, Linn.

ARUM.
maculatum, Linn.

GLYCERIA.
aquatica, Sm.

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## IV.—THE FERNS, MOSSES, AND FUNGI.

BY DR BUCHANAN WHITE, F.L.S.

### (1) THE FERNS AND THEIR ALLIES.

From the general dryness of Kinnoull Hill, it is not on the whole very rich in ferns, and possesses one species only which has any claim to be considered rare. The species in question is the Scaly Spleenwort *(Asplenium Ceterach)*, which has been known to grow there for about a century, as the locality is mentioned in Lightfoot's *Flora Scotica.* It is by no means abundant, and I do not intend to indicate the precise locality, but should any one find it, it is hoped that they will not do anything to make the plant rarer than it is at present.

Three other ferns are interesting from the places where they grow, as they are within the municipal boundaries. The most remarkable of these is the Brittle Bladder-Fern *(Cystopteris fragilis)*, of which a single specimen grows (or grew) on a dry wall on the Muirhall Road, a very curious place for a plant which prefers damp and shady rocks and banks. I know no other locality for it in the district. It is a species, however, that grows very readily, and I find it springing up of itself in my rock-garden, where it is the only fern that is self-sown. The other town ferns are the Wall-rue (*Asplenium ruta-muraria*), and the Male Fern (*Lastrea filix mas*). Of these, the first abounds on the back of my garden wall (it is common on other walls outside the municipal boundaries); and the second on the top of a wall at Bowerswell. (Both species I have seen even nearer the centre of the town.) Another fern—the Hart's Tongue—has been reported to me as having been found not far from Kinnoull churchyard, and I believe the report was correct; but whether it is there now, or whether it could be claimed as a native, I cannot say. The other ferns of Kinnoull Hill do not merit any lengthy notice. The Oak Fern has been reported to me, but I have not seen it; nor can I remember ever having seen the Bracken, whose absence is more remarkable. Of the allies of the ferns there are two, of which one only needs special mention, namely, the Fir Club Moss (*Lycopodium Selago*). Of this I once saw a single specimen close to the highest point of the hill.

### (2) THE MOSSES.

The moss flora of the hill has not been worked to the extent that it deserves. In fact, almost all that we know of it is the result of a very few days' labour when I was interested in mosses some years ago. The result of that work is a list of upwards of 120 species, or more than one-fifth of the British mosses; and the list could probably have many additions made to it by further explorations. Though the cliffs afford the best field to the bryologist, the woods and the banks of the river at Barnhill yield some species that are not on the rocks. Of the rock-loving mosses, the most interesting are *Grimmia subsquarrosa*, a species which was first discovered on Kinnoull Hill during the days I have mentioned, but which has since been found in various other places; and *Grimmia orbicularis*, a species of very local distribution. Amongst the wood-frequenting species may be mentioned the beautiful ostrich-plume feather-moss,—the most lovely, I think, of all our larger mosses; and the very rare *Campylopus brevifolius*. Of the river-side mosses, *Leskea polycarpa* and *Thuidium recognitum* are the most notable for their rarity. As illustrating the way in which species may disappear from the flora of the district we have under consideration, we may instance *Rhynchostegium murale*. This moss covered a stone in a ditch on the road to Kin-

noull Hill, and this was the only place where I have seen the moss near Perth. So far as I know, the stone remains in the same place, but the ditch has been covered in and a footpath made on the top, and so the moss has vanished.

### (3) THE FUNGI.

As with the mosses, so with the fungi. The district is well worth exploration, but only a few days have been devoted to it, with the result that a list of about 270 species can be drawn up. It is probable that further investigation would easily double this list. The richest spot for fungi on Kinnoull Hill was a grove of silver firs just behind Corsiehill, but as many of the trees have been cut down, I fear that it may not now be so fertile. On a calm bright day in late autumn the sight presented by this grove was very entrancing. The grey boles of the firs, gigantic yet most elegant, rose upwards at not too close intervals from a soft bed of mosses of every hue from pale golden and silvery green to that of the deepest and most intense; while high overhead the graceful foliage of the trees formed a delicate fretwork against the blue of the sky. On the mossy beds below, fungi of the most brilliant colours and the most diverse shapes were profusely scattered. Caps and cornucopias of righ dark brown; tapering forms, single and in clusters, of white and yellow; and caps of intense scarlet, rose, purple, grey, brown, yellow, and green, were amongst the many beautiful toadstools that adorned this fairy spot. But they were only toadstools, and hence despised!

I need not now enter into a lengthy description of the various species beyond mentioning that several kinds which had not before, and have not I think since, been found in Britain, were gathered here. Perhaps I should also say that the appended list does not refer to the grove at Corsiehill only, but to the whole district.

[*The Lists of Species will be found at the end of the series of papers.*]

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## V.—The Insects.

By Mr S. T. Ellison.

Kinnoull Hill is a favourite resort of the entomologist. Being within easy access of the city and possessing a tolerably rich and varied insect fauna, the lover of this branch of natural history will be often found wending his way thitherwards. The task of working up the insects of any locality, if taken up by one individual only, must entail a considerable amount of work, spread over a lengthened period. He will need to be not only assiduous in his exertions, but constant in his labours. It will not do to imagine that one or two visits to a locality will give even a fair knowledge of its insects; no, it must be visited repeatedly in spring, in summer, in autumn, and in winter, during all hours of the day, and I might almost add of the night also.

Numerous though my visits have been of late years to Kinnoull, I should certainly have hesitated before undertaking the task of writing upon its Lepidoptera for this series of papers had I only my own experience to guide me. Fortunately, I have been able to profit by the experience of some of those who have worked the hill in years gone by. Although the syllabus credits me with the duty of speaking upon the insects of Kinnoull, I am sorry I can only undertake one group, the others being beyond my sphere; and I have been unable to gather any information regarding them, so little has been done towards their elucidation. I can only hope that the scant knowledge we possess of all the orders of insects, other than the Lepidoptera, may induce some enthusiastic member or members of our Society, not otherwise engaged, to give their attention to some of these tribes. I can promise them a most interesting study, as well as a health-giving pursuit; and if they are not rewarded by making some additions to the List of British Insects, they are certain to add very materially to the Perthshire List.

In presenting a list of the Lepidoptera, it is of course impossible to call it complete, because at no time can the fauna of any district be said to be stationary,—there are always some species falling away and others appearing. I think I am justified, however, in saying that the Macro-Lepidoptera have been well worked. Of the Micros, I cannot say the list is as exhaustive as I would have liked it to have been, less attention having been given to these smaller species.

If any of you have ever accomplished a wonderful journey, we sometimes see advertised, of round the world in the short space of about sixty minutes, you will be somewhat prepared for a performance equally wonderful in its way which I am going to ask you to undertake with me to-night, that is, to compress within the compass of six or seven minutes a year's insect hunting on the top of Kinnoull Hill. Assuming then, that we have collected and arranged all the apparatus necessary for so protracted an excursion, we may about the beginning, say, of November wend our way towards the Hill. After passing Bowerswell we will call a halt for a few minutes to notice a spot sacred to the memory of *Dasypolia Templi*. It was on the second lamp past the well that Dr Buchanan White took the first Perthshire example of this rare insect. Continuing our ascent, I may say the hedges and banks (especially on the left-hand side) during the spring months afford food and shelter for many species of Noctua larvæ. We shall arrive at the hill at a time of year when there is a paucity of insect life, so may spend a little time in noticing the kinds and distribution of the trees. It will be found that the foot of the hill proper, from the entrance gate round as far as Corsie Hill, is principally covered with oak trees. Birch is most numerous around Corsie Hill. The open parts near the top are covered with heather and blaeberry, while spruces and larch and a few Scots firs, with beech, ash, and hawthorn, not only add to the characteristic beauty of

the hill, but lead us to anticipate that its insect treasures will alike be varied.

The first four months of our sojourn (i.e., November, December, January, and February) we shall meet with our winter insects, and shall probably find all the members belonging to the genera *Hybernia*, *Anisopteryx*, and *Cheimatobia*. What is most to be noted about these insects is, the females are all either entirely wingless or their wings are in a rudimentary condition, forbidding them the power of aerial motion. It is rather remarkable that (excepting the Psychidæ) all the Lepidoptera whose females are apterous, pass their perfect state during the whole or a portion of our winter. Disuse was no doubt the cause of the loss of these organs, but the distribution of these insects would seem to carry this change a long way back in time. With the advance of the year our work will increase. During March and April we may during the day search carefully the tree-trunks. If there are any solitary wanderers on the hill, we may expect our zeal will arouse their curiosity. I suppose, from the way they either watch or seem to shun one, that they must imagine anyone so interested in examining the trees must have escaped from some place of restraint. Consoling ourselves that we have become martyrs to science, we may expect that the prosecution of our search will reward us with, at least, not a few of *Diurnea fagella* with its semi-winged lady. In the sunshine another *Tinea*, *Exapate congelatella* may be boxed in numbers. On the birch trees one or more solitary specimens may be obtained of *Asphalia flavicornis*. At night, on lighting our lamp, the first visitor will probably be *Larentia multistrigaria;* and by searching among the grass we may possibly find those pretty geometers, *Anticlea badiata* and *A. nigrofasciaria*, as well as the commoner *Depressaria ocellella*. The sallows will now be fully out, and on a mild evening we may expect to find many insects that have "sped to the lure."

Selecting a bush that can easily be worked, we spread a large sheet underneath it. On giving the bush a shake, great will be our delight to see such an assemblage of insects lying on our sheet. It is, however, sad to have to relate that they are all in an incapable condition. Unlike some unfortunates, they soon recover, and will make off unless we quickly make them secure. Amongst them are some of the newly-emerged members of the genus *Tæniocampa*, with the rarer *Panoplis piniperda*, as well as some of those species which have endured the cold of winter in their perfect state. With the advent of May, a careful search should be instituted on the open parts among blaeberry, for one of our earliest butterflies, the little green Hairstreak *(Thecla rubi)*.

I am sorry to say that of late years this little butterfly has become very scarce on the hill compared with what it used to be some years ago. Inspection of the trunks of the larch trees will doubtless produce *Tephrosia crepuscularia*, and *Cidaria suffumata* will be netted on the wing. In the bright sunshine, flying up and down around a beach or birch, the pretty little *Adela viridella*, with its long antennæ, may sometimes be netted in good numbers. The members of the genus *Notodonta* will now be emerging from the pupæ, as well as the two representatives of the genus *Dicranura (vinula* and *furcula)*. Among the former I have taken the eggs or larvæ of *dictæoides*, *camelina*, and *dromedarius*. Our evenings may be employed looking for the larvæ of many of the Noctuæ, which, being nearly full fed, will give us but little trouble, and from which we may expect to rear some fine imagines. In June we shall find among the oaks such insects as *Zonosma punctaria* (commonly called "The Maiden's Blush"), *Boarmia repandata*, and at rest on the trunks an odd *Apleeta nebulosa*, as well as an occasional *Nola confusalis*. Of Micros, the oaks, too, will yield us the bright and showy though abundant *Gracilaria alchimiella*, and also the long-horned *Nemophora Swammerdamella*. The larches and firs give *Thera variata*, *Eupithecia lariciata*, and *Coccyx Hercyniana*.

July will bring the crisis of our work, and we can find employment collecting from early morning to late at night. One butterfly should be looked for; it is *Pararge Egeria*, a scarce butterfly with us. I never took but one example, on the side of the hill beyond the old castle. Dr Buchanan White tells me he has taken it in two places on this side, but it has always been a rare insect here. By beating the oaks we may dislodge *Metrocampa margaritata*, *Crocalis elinguaria*, and *Calymnia trapezina*,—the cannabilistic propensities of the larvæ of the two last named making them dreaded foes in that stage. The little *Tortrix viridana* often becomes very destructive to the oaks. The birches will reward our beating with two Tineæ, *Swammerdammia griseocapitella* and the metallic-striped *Argyresthia brochella*. Hawthorn will produce *Argyresthia nitidella*, and firs *Stigmonota coniferana*, *Retinia pinivorana*, as well as the rather rare *Cedestis Gysselinella*. With the approach of darkness we may make our way to the top of the hill, and by the light of our lanterns obtain a good series of *Gnophos obscuraria* and *Dasydia obfuscaria*. August will bring out in large force the Noctua, among them such species as *Hydræcia micacea*, *Noctua baia*, *N. neglecta*, and *Mania typica*, as well as the underwings *(Triphæna)*. For these and many others we may now try, with every confidence of success, sugaring the trees. During the sunshine, near the cliffs and upon the open parts at the top of the hill, the grayling butterfly *(Satyrus semele)* will be found abundantly. September and October will bring us such different insects as *Cidaria miata* and *Chesias spartiata*, *Himera pennaria*, and *Agriopis aprilina*, *Lemnatophila phryganella* and *Peronea ferrugana*, as well as members of that difficult genus *Oporabia*.

Most of the insects I have mentioned hitherto can be obtained almost any year, and I would now like to say a few words upon some insects which have occurred on the hill, and are, therefore, included in the list I append to this paper, but which for many years have disappeared. The most prominent is the Wall Brown butterfly *(Pararge Megæra)*. This insect used to be found commonly on the road to Kinnoull, but has not been seen since 1860. On looking up Newman, I find he quotes Dr Buchanan White upon its extinction in Perthshire thus:—"It was formerly common near Perth; he has heard of no specimen being taken since 1860, in which year it was common. The series of cold summers following that year seem to have destroyed the species, though pos-

sibly, like *Pyrameis cardui*, it may again put in an appearance. It is found in Scotland as far north as Argyle." After the lapse of so long a period I do not think this butterfly is ever likely to turn up here again: Its habits restrict it to the locality in which it is bred, and in this respect it differs extremely from *P. cardui*, whose roaming disposition is notorious. Another insect in the list not now to be found, so far as I have been able to note, within our bounds, is *Bombyx rubi*, but it is quite likely this and several other insects which have not been noticed recently will reappear. Descending the hill past Annat Lodge, I may say Dr Buchanan White tells me he saw this last summer a specimen of that beautiful butterfly, *Argynnis Aglaia*, in his garden; and on his rockery I have myself taken the tiny *Micropteryx Seppella*. Other two insects not recorded from any other part of the hill have visited Annat Lodge, flying to the lighted windows, viz., *Luperina cespitis* and *Phycis subornatella*. I suppose they went to report themselves to our President—at any rate the visit ensured their inclusion in our list. As one can hardly believe so small an insect as the last named could fly all the way from Moncreiffe, where it is pretty common, I think we may reasonably expect to find it elsewhere within our boundary.

The following analysis of the list appended shows the number of Kinnoull species, as compared with the total number of Perthshire apecies:—

| | *Kinnoull.* | *Perthshire.* |
|---|---|---|
| Rhopalocera, | 19 | 31 |
| Sphinges and Bombyces, | 27 | 65 |
| Noctuæ, | 64 | 160 |
| Geometræ, | 70 | 145 |
| Pyralides, | 7 | 28 |
| Pterophori, | 2 | 10 |
| Crambi, | 5 | 22 |
| Tortrices, | 20 | 160 |
| Tineæ, | 20 | 200 |

As I have previously stated, much remains yet to be done among the Tortrices and Tineæ, and I feel sure these will yet be largely added to.

[*The List of Species will be found at the end of the series of papers.*]

## VI.—The Mollusca.

By Mr Henry Coates, F.R.P.S.

I know of few places which present, within an equally limited area, so many conditions favourable for the habitat of land mollusks as Kinnoull Hill. Amongst these conditions may be mentioned the crumbling basalt rock, the southern exposure, the shelter afforded by the trees and vegetation which edge the cliffs, and the variety of altitude.

Let us suppose we have descended one of the steep gullies which lie beween the jutting cliffs, and have lain down on the loose *debris*, just at the edge of the solid rock. We then commence carefully to examine all the loose soil, moss, sticks, leaves, and stones within reach, handful by handful. If the day be suitable, say a damp, warm afternoon in early autumn, nearly every handful we take up will contain some interesting specimens, the majority of them very minute, but all exquisitely graceful in form, some wonderfully sculptured, and others prettily coloured. I should have mentioned that the only appliances necessary to take with us are a few pill-boxes of different sizes, a bag in which to put some *debris* for examination at home, and—for those whose eyes are not sharp enough to distinguish *Helix pygmæa* from a grain of sand—a pocket lens.

Let us see then what we have culled from the first few handfuls. The largest are one or two rounded shells, about ¼ inch across, of a dark brown colour, and covered with down-like hairs. Through the semi-transparent shell we can see that in some the animal is nearly black, and in others a dirty white. These represent two closely allied species (*Helix hispida* and *H. concinna*). Next we may notice some little wide-mouthed shells of a delicate sea-green colour, and almost as transparent as glass (*Vitrina pellucida*). These are nearly all empty, probably for the reason that they afford but slight protection to their occupants, who thus fall an easy prey to birds and other enemies. Probably the commonest form is a little spiral shell of a dark brown colour, strong and opaque. At first sight these seem to be all the same, but if we examine them closely we may find that one or two have a white rib strengthening the edge of the lip (*Pupa umbilicata* and *P. marginata*). Amongst the more minute shells, clinging to dead twigs and leaves or chips of rock, are three resembling each other in their round flattened shape. The first of these is a most beautiful object, when seen under a magnifying glass, milk-white, semi-transparent, and with the mouth surrounded by a porcelain-like ring (*H. pulchella*). The next is of a rich olive brown colour, and sculptured with regular curved striæ radiating from the centre (*H. rupestris*). The smallest of the three is equally beautiful in structure, although so minute that only a practised eye can detect it (*H. pygmæa*).

Such are a few of the more abundant species, described in entirely unscientific terms. If we have selected our spot well, we may expect to unearth at least as many more without moving a dozen yards. But, leaving the loose material, we shall now take a glance at the rock of the cliff itself. Here we shall see—some crawling over the exposed surface, some hiding in chinks and crannies—a number of little snails, carrying slender spiral shells, about half-an-inch long and tapering at both

ends (*Clausilia rugosa*). The appearance they present is rather curious, as the shell is carried sticking out from the surface of the rock at an oblique angle, and not only the rocks, but the stems of many of the trees are serrated with these tiny spear points. On one rock, which I need not particularise, are found some shells belonging to an allied species, which are considerably larger, paler, and more glossy (*C. laminata*). This little colony, confined within an area of not many square yards, presents one of those problems of geographical biology which are so difficult to solve, as we should have to travel southwards for 200 or 300 miles before we came upon another colony of the same species. Is this isolated group the last remnant of a more extended distribution of the species, or is it the result of some individual specimens naturally or artificially introduced? And if the climate is suited to its habits, why is it not found in other parts of Scotland? We are indebted to Dr Buchanan White for the discovery on Kinnoull Hill of this most interesting species.

We shall now conclude our hasty excursion by going down to the rocks at the foot of the hill. Here we meet with another example of isolated distribution, not so remarkable as the last, but yet presenting some interesting features. The snail which, in England, is by far the most abundant of the shell-bearing species, is almost entirely confined, in Scotland, to the maritime districts. A colony of this species (*Helix aspersa*) at the foot of Kinnoull Hill presents one of the exceptions to this, and a still more remarkable exception is to be found in the case of a specimen which I lately learned had been met with by the side of Loch Tay. This single specimen probably owes introduction into the Breadalbane Highlands to some accidental circumstance, but it seems to me just possible that the occurrence of the Barnhill colony may point to a time when the surface of the country was at a lower level than it now is, when the Tay at this point was a broad, brackish estuary, and when the conditions of the district were distinctly maritime. That such estuarine conditions did once obtain, we have ample evidence from the marine diatoms of the Carse clays, of which we had an account in the interesting paper lately read by Dr Trotter.

Although we have been examining chiefly the rocks and stones, it must not be inferred that these form the only habitats of land mollusca. There is one genus in particular whose favourite hiding-place is underneath loose tufts of damp moss (*Zonites*). Of this genus seven species are found on Kinnoull Hill. These are characterised by their flat coiled shells, which are semi-transparent, and generally amber or pale horn coloured. One species makes its presence known by the powerful odour of garlic which it emits.

Fresh-water shells are, of course, but meagrely represented in one or two pools at the top of the hill, unless we include the River Tay, which flows at its foot, and forms one of its boundaries.

[*The List of Species will be found at the end of the series of papers.*]

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## VII.—The Vertebrates.

By Dr Buchanan White, F.L.S.

A district such as Kinnoull, presenting a varied mixture of gardens and cultivated fields, woodland and rocky declivities, is, as may be supposed, not destitute of a rather large population of birds and the smaller mammals, though at the same time it is rather too near the abodes of men for the wilder denizens of the fields and woods. The most interesting point of this portion of our subject lies in the comparatively large number of species that occur actually within the boundaries of the town itself, and within less than half-a-mile from St John's Church, round which Perth has been built. In this account, therefore, of the vertebrate animals of the district, it seems desirable to chiefly notice those that have been observed within the municipal boundaries. Of these I have seen by far the greater part in my own garden, which, though not more than about three acres in extent, has a rather large fauna, which, however, it doubtless shares with other gardens in the neighbourhood.

To begin with the mammals. We have about nineteen species in the district, and of these no less than thirteen or fourteen occur within the town boundaries. Of these, three —the common bat or pipistrelle, the brown rat, and the house mouse—are ubiquitous, and require nothing further than mere mention. The long-eared bat I have not actually seen, but I believe that certain shrill squeaks which may be heard after dark on autumn nights indicate its presence. The hedgehog is of common occurrence, and seems to be permanently resident. Some years ago I gave the Society a short account of the winter nest of one in my "rock-garden." For two successive years there was a winter nest in the same spot, but whether made by the same individual it is impossible to say. This year, however, I have not seen it. Squirrels—whose graceful movements

always command admiration—are not unfrequent visitors to my oaks and beeches, and sometimes actually come into the house. Rabbits are rather too common, and though they do not make burrows, yet they take up their abode and make themselves quite at home. Though it is interesting to see the young ones playing on the grass, it is not quite so amusing when an old rabbit makes its summer quarters in the midst of a collection of alpine plants. Hares are less abundant, but every now and then one appears, though it does not stay very long. Of the smaller animals the common shrew and long-tailed field mouse are the commonest, though at the same time they keep pretty well out of sight. A much rarer creature is the red field vole, and though I cannot be quite certain about its identity, I feel convinced that a vole I saw running about one day in my "herbaceous border" belonged to this species. The red field-vole is of very local occurrence (or has been overlooked) in Perthshire. I know of only two other localities for it.

The remaining two species which have occurred within the municipal boundaries are denizens of the Tay, and only occasionally come up the river so high as Perth Bridge. One—the common seal—is perhaps not very rare, but the other—the common porpoise—is seldom seen. The mammals of the district which so far as known have not ventured within the town's boundaries—though at the same time it is very probable that three out of the five may occasionally or even commonly do so—are the mole, weasel, and stoat; the fox, which has been seen in the woods; and the roe-deer.

We now pass on to the birds. Ornithology not being a special study of mine, I regret that it is impossible on this occasion to say how many species have actually occurred in the district. At the same time I do not think I am far wrong in stating that the number is about 65. Of these I am certain of 45, thus leaving 20 whose occurrence, though we cannot at present vouch for them, is yet extremely probable. The birds which nest in the district are at least 34.

As in the case of the mammals, we will devote more particular attention to the species which have been seen within the town boundaries, and I may again say that it is in my own garden that most, if not all, of these have been noticed—chiefly no doubt for the reason that that spot of ground has been naturally more subjected to observation on my part, but perhaps also because some pains have been taken to protect and encourage the feathered visitors thereto. Some people who have gardens are rather doubtful as to the expediency of encouraging birds, since their fruit must suffer thereby to a greater or less extent. But such persons must forget that if birds take a little fruit, they more than compensate for their depredations by the numbers of injurious insects that they consume; and that moreover it is quite possible to protect the fruit without killing the birds. Apart altogether from the positive benefits arising from the presence of birds in a garden, a great amount of pleasure may be derived from them. Throughout the whole year the presence of these active and many-coloured creatures imparts a sense of life to the scene. Flitting from tree to tree, hopping about the grass, or diligently searching amongst the taller plants in a flower border, each bird by its different habits provides an endless and ever-pleasurable subject for study and observation. And then, on a fine morning or evening in spring or early summer, how delightful it is to listen to the medley of sweet voices ringing from every bush and tree.

The most notable of our songsters are the blackbird and the thrush. Of these the former is exceedingly abundant; and while the latter is not rare, yet its numbers were considerably reduced by the severe winters we had a few years ago. Blackbirds with some white feathers are not very rare. I used to see one that had two or three of its tail feathers white, and at Barnhill (which is, however, beyond the municipal boundaries) there were for several years a number of blackbirds very much marked with white. Both species nest in my garden. The missel-thrush, on the other hand, I have seen only in winter. Some tall holly trees seem to be the attraction, as one or more of the birds are constantly feeding on the berries. The red-breast—or, as it is more often called, the robin,—as usual makes itself quite at home, not only coming into the house, but being bold enough—with a little encouragement—even to pick up crumbs out of one's hand. Frequently, when writing in the garden, a robin has come and hopped about the spars of the chair on which I have been sitting; and whenever any gardening operations are being done, a robin is sure to approach to see what is going on. The willow wren is another common bird, and, in company with the robin, frequently makes its nest in my rock garden. It has not, however, the robin's fearlessness, as it shows considerable hesitation in entering its nest while anyone is looking on, and hops about from bush to bush, longing yet fearing to convey to its young ones the choice caterpillar it has in its beak. Let the spectator, however, turn his back for a moment, and the shrill cries of the nestlings tell that the mother bird has darted into the nest. Another pleasing bird is the hedge-sparrow, with its modest garb of brown tinged with blue. Its neat nest is not very rare, while the bird itself delights

to creep and hop about amongst the plants which grow below the window where I am writing. Of the titmice, two, if not three, species occur, and occasionally nest—an old pump was a favourite place for their nesting, the birds entering by the spout. If any one wishes to see titmice to advantage, let them stretch a cord in sight of the window, and hang on to it some bits of suet or bones. The titmice will soon find these out, and their antics as they come to feed are very amusing. Often they run along the underside of the cord with body and head hanging downwards. The species seen are the great titmouse and the blue titmouse. The tree-creeper is another bird that is more interesting from its habits than its beauty. It gets its name from the manner in which it creeps about the bark of trees, peering into every cranny for its insect prey. When ascending the bole of a tree, its tail is used to assist its claws in climbing. It is not common in the garden, and I have not seen the nest. Merely mentioning the wren and the pied wagtail, neither of which are common with me, we must devote a line to the spotted flycatcher on account of the frequency with which it selects the same spot for its nest year after year. One pair only nests here, and their favourite place is a quite exposed hollow in the trunk of an old pear tree against a wall. There is not the very slightest attempt to conceal the nest, and as it is directly exposed to the sun, the bird when sitting in it must be nearly roasted.

Swallows and house-martins are frequent. There are always several nests of the former, and though I have not found the nests of the latter, I think there must be some close at hand. Of late years the house-martin seems to be getting commoner in Perthshire than it used to be; and if this is so, I do not know the reason. A very pretty sight that I saw one autumn was that of two or three hundred martins sunning themselves on the roof of the house preparatory to their migration.

Passing over the greenfinch, chaffinch, and linnet, all of which nest in the garden, the house-sparrow deserves a word of mention. When I came to this house, sparrows were not common here, nor were they for some years. One day a travelling threshing-mill came to the farm behind the garden, and with it came a lot of sparrows, and ever since that time they have been more abundant here, though not so common as they are in the streets of the town.

The yellow-hammer is rare, but every year during the nesting season a pair may frequently be seen at one corner of a hedge, and from the constancy with which they come to this spot it is probable that they are the same individuals.

Starlings are abundant, and very pretty a flock of them looks as they diligently hunt for food on the lawn, their iridescent plumage glittering in the sunshine; but their waddling gait looks awkward in contrast with the active hops of the blackbird and thrush. Jackdaws and rooks are also common, and scarcely deserve special mention, except to point out that the latter seem rather crotchety in selecting nesting-places. There are, as you know, numbers of nests in various places in Bridgend, but though there are many suitable trees here, the rooks have never, except on one occasion, attempted to build, and then they never completed the nest.

The swift, heron, sparrowhawk, and blackheaded gull can be included in this list only on account of their more or less frequent passage over the garden; and the cuckoo ought perhaps not to find a place either, as I have not seen it. As, however, I have heard it on various sides, it may possibly come into the garden sometimes. Considering how abundant this bird is on some of the moorlands of Perthshire, it is a little curious how comparatively scarce it is near Perth.

Woodpigeons—so common in the woods on the hill—rarely come into the garden, and only when compelled by stress of weather and want of food. Then they do come, and the vegetables suffer in consequence. Of game birds, partridges and pheasants are not unfrequent visitors, but rarely stay for any length of time.

As I write, I am enabled to add another bird to the garden fauna, having just seen a redwing on the grass in front of the window.

The last bird that remains to be noticed is the corncrake. Though its note is so harsh, there is something pleasing in it from its association with the sweet evenings of early summer. Though essentially a country bird, I have yet heard it within a few yards of Perth Bridge, and it is a regular summer visitant, if not to the garden, yet to the close vicinity. One day when writing at this window I was much surprised to see a corncrake running along close to the house, and trying, or appearing to try, to look in at the windows.

I feel that a word of apology is due to you for having occupied so much of your time with an account of the bird fauna of my own garden. My excuse must be the desire to show how much pleasure can be derived from a study of the bird life of even a limited town garden.

Of the birds that occur in the district beyond the municipal boundaries much need not be said. The kingfisher I have seen once at the Willowgate. The capercailzie and woodcock nest on the hill. In the cliffs the swift, jackdaw, and kestril find a congenial home; and there is

evidence that once that noble falcon, the peregrine, nested there, which it would probably do again if freed from persecution.*

Of the reptiles and amphibians of Kinnoull Hill there is not much to be said. The slow worm and viviparous lizard are reported to occur, but I have not seen either. The common newt is also an inhabitant, and so are the frog and the toad, — the latter being the commonest. Both of these species I have seen in my rock garden, where, in raking up some leaves the other day, I turned up a fat toad, the first I think I ever saw in winter. The toad is a very desirable animal (as is also the frog) to have in a garden, and should be protected, and not knocked on the head, as is too often done by ignorant and cruel gardeners. It may not be generally known that the toad is rather a clever climber, and can make his way up perpendicular surfaces with a comparative facility that would not be suspected.

Of fishes, there are strictly speaking none on Kinnoull Hill, but as we included in our lists several plants and animals that occur in the River Tay where it bounds the district, we ought, I suppose, to include the fishes also. In that case we have in our fauna eight or more species, as follows :—Minnow, allis shad, salmon, sea-trout, common trout, sharp-nosed eel, lampern, and flounder.

* Since writing the above, I have heard that an eagle (presumably the Golden Eagle) was once seen on Kinnoull Hill.—F. B. W.

## IV.—LIST OF FERNS, MOSSES, & FUNGI.

### (1). FERNS, &c.

FILICES.

LOMARIA.
Spicant, Desv.

ASPLENIUM.
Ruta-muraria, L.
Trichomanes, L.
Adiantum-nigrum, L.
Filix-fœmina, Bernh.
Ceterach, L.

SCOLOPENDRIUM.
vulgare, Sm.

CYSTOPTERIS.
fragilis, Bernh.

ASPIDIUM.
aculeatum, Sw.

NEPHRODIUM.
Filix-mas, Rich.
spinulosum, Dsv.
dilitatum, Dsv.

POLYPODIUM.
vulgare, L.

EQUISETACEÆ.

EQUISETUM.
arvense, L.

LYCOPODIACEÆ.

LYCOPODIUM.
Selago, L.

### (2). MOSSES.

SPHAGNACEÆ.

SPHAGNUM.
acutifolium, Ehrh.

ANDREÆACEÆ.

ANDREÆA.
petrophila, Ehrh.

WEISSIACEÆ.

GYMNOSTOMUM.
microstomum, Hedw.

WEISSIA.
viridula, Brid.

DICRANELLA.
heteromalla, Hedw.

DICRANUM.
scoparium, L.
majus, Turn.

CAMPYLOPUS.
flexuosus, Brid.
brevifolius, Schpr.

BRUCHIACEÆ.

PLEURIDIUM.
alternifolium, B. & S.

POTTIACEÆ.

PHASCUM.
cuspidatum, Schreb.

POTTIA.
truncata, L.

DIDYMODON.
rubellus, B. & S.

DITRICHUM.
flexicaule, Schwg.

BARBULA.
muralis, L.
var. rupestris, Schultz.
unguiculata, Dill.
fallax, Hedw.
spadicea, Mitt.
tortuosa, L.
subulata, L.
lævipila, Brid.
intermedia, Brid.
papillosa, Wils.

CERATODON.
purpureus, L.

CALYMPERACEÆ.

ENCALYPTA.
vulgaris, Hedw.

GRIMMIACEÆ.

GRIMMIA.
apocarpa, L.
orbicularis, B. & S.
pulvinata, Dill.
subsquarrosa, Wils.
trichophylla, Grev.

RHACOMITRIUM.
aciculare, L.
heterostichum, Hedw.
fasciculare, Schrad.
lanuginosum, Hedw.
canescens, Hedw.

PTYCHOMITRIUM.
polyphyllum, Dicks.

ZYGODON.
viridissimus, Dicks.

ULOTA.
Bruchii, Hornsch.
crispa, Hedw.

ORTHOTRICHUM.
saxatile, Brid.
rupestre, Schleicb.
affine, Schrad.
stramineum, Hornsch.
diaphanum, Schrad.
Lyellii, H. & T.
leiocarpum, B. & S.

FUNARIACEÆ.

EPHEMERUM.
serratum, Schreb.

ENTOSTHODON.
ericetorum, Bals.

FUNARIA.
fascicularis, Dicks.
hygrometrica, L.

BARTRAMIACEÆ.

BARTRAMIA.
pomiformis, L.

PHILONOTIS.
fontana, L.

BRYACEÆ.

WEBERA.
nutans, Schreb.
albicans, Wahl.

BRYUM.
intermedium, W. & M.
alpinum, L.
cæspiticium, L.
argenteum, L.
capillare, L.
pallens, Swartz.
pseudo-triquetrum, Hedw.

MNIACEÆ.

MNIUM.
cuspidatum, Hedw.
undulatum, Hedw.
hornum, L.
serratum, Schrad.
punctatum, Hedw.
subglobosum, B. & S.

AULACOMNIUM.
palustre, L.

POLYTRICHACEÆ.

ATRICHUM.
undulatum, L.

POGONATUM.
aloides, Hedw.
urnigerum, L.

POLYTRICHUM.
piliferum, Schreb.
juniperinum, Willd.
commune, L.

FISSIDENTACEÆ.
FISSIDENS.
bryoides, Hedw.
adiantoides, Hedw.
RIPARIACEÆ.
CINCLIDOTUS.
fontinaloides, Hedw.
FONTINALIS.
antipyretica, L.
CRYPHÆACEÆ.
HEDWIGIA.
ciliata, Dicks.
NECKERACEÆ.
NECKERA.
complanata, L.
HOMALIA.
trichomanoides, Schreb.
LESKEACEÆ.
LESKEA.
polycarpa, Ehrh.
ANOMODON.
viticulosus, L.
THUIDIUM.
tamariscinum, Hedw.
recognitum, Hedw.
HYPNACEÆ.
PTERIGYNANDRUM.
filiforme, Timm.
THAMNIUM.
alopecurum, L.
CLIMACIUM.
dendroides, L.
ISOTHECIUM.
myurum, Poll.
HOMALOTHECIUM.
sericeum, L.
CAMPTOTHECIUM.
lutescens, Huds.
BRACHYTHECIUM.
albicans, Neck.
velutinum, L.
rutabulum, L.
rivulare, B. & S.
populeum, Hedw.
plumosum, Swartz.
EURHYNCHIUM.
myosuroides, L.
prælongum, Dill.
pumilum, Wils.
RHYNCHOSTEGIUM.
confertum, Dicks.
murale, Hedw.
ruscifolium, Neck.
PLAGIOTHECIUM.
denticulatum, L.
undulatum, L.
AMBLYSTEGIUM.
serpens, L.
HYPNUM.
uncinatum, Hedw.
filicinum, L.
cupressiforme, L.
resupinatum, Wils.
molluscum, Hedw.
crista-castrensis, L.
palustre, L.
chrysophyllum, Brid.
cuspidatum, L.
Schreberi, Ehrh.
purum, L.
HYLOCOMIUM.
splendens, Dill.
squarrosum, L.
loreum, L.
triquetrum, L.

## (3). FUNGI.

HYMENOMYCETES.
*AGARICINI.*
AGARICUS.
*Amanita.*
muscarius, L.
rubescens, Fr.
vaginatus, Fr.
*Lepiota.*
granulosus, Batsch.
amianthinus, Sc.
*Armillaria.*
melleus, Vahl.
*Tricholoma.*
equestris, L.
portentosus, Fr.
rutilans, Schæff.
columbetta, Fr.
vaccinus, P.
terreus, Schæff.
virgatus, Fr.
lascivus, Fr.
*Clitocybe.*
clavipes, P.
odorus, Bull.
infundibuliformis, [Schæff.
brumalis, Fr.
fragrans, Sow.
laccatus, Scop.
*Collybia.*
radicatus, Rebl.
maculatus, A. & S.
butyraceus, Bull.
velutipes, Curt.
tuberosus, Bull.
tenacellus, P.
dryophilus, Bull.
*Mycena.*
aurantiomarginatus, Fr.
purus, P.
rugosus, Fr.
galericulatus, Sc.
dissiliens, Fr.
*Mycena*—Continued.
alcalinus, Fr.
ætites, Fr.
epipterygius, Sc.
tenerrimus, B.
*Omphalia.*
umbelliferus, L.
*Pleurotus.*
applicatus, Batsch.
unguicularis, Fr.
*Nolanea.*
pascuus, P.
*Pholiota.*
squarrosus, Mull.
spectabilis, Fr.
*Inocybe.*
auricomus, Batsch.
sambucinus, Fr.
geophyllus, Sow.
*Hebeloma.*
fastibilis, Fr.
elatus, Batsch.
*Naucoria.*
melinoides, Fr.
*Galera.*
tener, Schæff.
*Tubaria.*
furfuraceus, P.
*Crepidotus.*
mollis, Schæff.
*Psalliota.*
arvensis, Schæff.
campestris, L.
silvaticus, Schæff.
*Stropharia.*
æruginosus, Curt.
semiglobatus, Batsch.
*Hypholoma.*
sublateritius, Schæff.
epixanthus, Fr.
fascicularis, Huds.
*Psilocybe.*
agrarius, Fr.
semilanceatus, Fr.
COPRINUS.
comatus, Fr.
micaceus, Fr.
plicatilis, Fr.
CORTINARIUS.
*Phlegmacium.*
cyanopus, Fr.
*Myxacium.*
elatior, Fr.
*Inoloma.*
violaceus, Fr.
*Dermocybe.*
cinnamomeus, Fr.
orellanus, Fr.
*Telamonia.*
torvus, Fr.
evernius, Fr.
helvolus, Fr.
hinnuleus, Fr.
gentilis, Fr.
*Hydrocybe.*
duracinus, Fr.
acutus, Fr.
GOMPHIDIUS.
glutinosus, Fr.
PAXILLUS.
involutus, Fr.
HYGROPHORUS.
hypothejus, Fr.
pratensis, Fr.
virgineus, Fr.
ovinus, Fr.
coccineus, Fr.
puniceus, Fr.
conicus, Fr.
chlorophanus, Fr.
psittacinus, Fr.
LACTARIUS.
torminosus, Fr.
turpis, Fr.
blennius, Fr.
pyrogalus, Fr.
vellereus, Fr.
deliciosus, Fr.
rufus, Fr.
glyciosmus, Fr.
volemum, Fr.
serifluus, Fr.
mitissimus, Fr.
subdulcis, Fr.
RUSSULA.
nigricans, Fr.
rosacea, Fr.
sardonia, Fr.
rubra, Fr.
cyanoxantha, Fr.
fœtens, Fr.
emetica, Fr.
ochroleuca, Fr.
integra, Fr.
alutacea, Fr.
CANTHARELLUS.
cibarius, Fr.
aurantiacus, Fr.
tubæformis, Fr.
MARASMIUS.
urens, Fr.
peronatus, Fr.
porreus, Fr.
oreades, Fr.
androsaceus, Fr.

*POLYPOREI.*
BOLETUS.
luteus, L.
flavus, With.
badius, Fr.
piperatus, Bull.
chrysenteron, Fr.
subtomentosus, L.
edulis, Bull.
luridus, Schæff.
laricinus, B.
scaber, Fr.

POLYPORUS.
squamosus, Fr.
giganteus, Fr.
adustus, Fr.
amorphus, Fr.
hispidus, Fr.
applanatus, Fr.
annosus, Fr.
versicolor, Fr.
abietinus, Fr.
terrestris, Fr.
vaporarius, Fr.
TRAMETES.
mollis, Somm.
MERULIUS.
lacrymans, Fr.

*HYDNEI.*

HYDNUM.
repandum, L.
RADULUM.
orbiculare, Fr.
GRANDINIA.
granulosa, Fr.

*THELEPHOREI.*

THELEPHORA.
palmata, Fr.
STEREUM.
purpureum, P.
hirsutum, Fr.
sanguinolentum, Fr.
rugosum, Fr.
CORTICIUM.
*Corticium.*
læve, P.
calceum, Fr.
incarnatum, Fr.
comedens, Fr.
*Peniophora.*
quercinum, Fr.
*Coniophora.*
laxum, Fr.
*Hypochnus.*
sambuci, Fr.
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amorphum, Fr.

*CLAVARIEI.*

CLAVARIA.
fastigiata, L.
cinerea, Bull.
cristata, P.
rugosa, Bull.
abietina, P.
grisea, P.
stricta, P.
inæqualis, Fl. Dan.
fragilis, Holms.
CALOCERA.
viscosa, Fr.

*TREMELLINEI.*

TREMELLA.
foliacea, P.
NÆMATELIA.
encephala, Fr.
DACRYMYCES.
deliquescens, Duby.
stillatus, Nees.

## GASTEROMYCETES.

*PHALLOIDEI.*

PHALLUS.
impudicus, L.

*TRICHOGASTRES.*

LYCOPERDON.
cælatum, Fr.
gemmatum, Fr.
SCLERODERMA.
vulgare, Fr.

*NIDULARIACEI.*

CRUCIBULUM.
vulgare, Tul.

## CONIOMYCETES.

*SPHÆRONEMEI.*

LEPTOTHYRIUM.
fragariæ, Lib.
pictum, B. & Br.
SEPTORIA.
scabiosæcola, Desm.
ASCOCHYTA.
dianthi, B.
CEUTHOSPORA.
lauri, Grev.

*TORULACEI.*

TORULA.
pulveracea, C.
herbarum, Lk.
sporendonema, B. & Br.

*PUCCINIÆI.*

PHRAGMIDIUM.
mucronatum, Lk.
bulbosum, Schl.
obtusum, Lk.
TRIPHRAGMIUM.
ulmariæ, Lk.
PUCCINIA.
graminis, P.
menthae, P.
scorodoniæ, Lk.
compositarum, Sch.
umbelliferarum, D. C.
violarum, Lk.
lychnidearum, Lk.
malvacearum, C.
luzulæ, Lib.

*CÆOMACEI.*

USTILAGO.
segetum, Ditm.
antherarum, Fr.
UROMYCES.
ficariæ, Lev.
i. Æcidium ficariæ, P.
fabæ, Fckl.
iii. Puccinia fabæ, Sh.
alchemillæ, D. C.
iii. Uromyces intrusa, Lev.
COLEOSPORIUM.
tussilaginis, Lev.
campanulæ, Lev.
sonchi-arvensis, Lev.
senecionis, Fr.
MELAMPSORA.
betulina, Desm.
populina, Lev.
CYSTOPUS.
candidus, Lev.
UREDO.
vacciniorum, P.
statices, Desm.
TRICHOBASIS.
suaveolens, Lev.
PROTOMYCES.
macrosporus, Ung.
SYNCHITRIUM.
mercurialis, Fckl.

*ÆCIDIACEI.*

ÆCIDIUM.
epilobii, D. C.
grossulariæ, D. C.
depauperans, Vize.
compositarum, Mart.
MILESIA.
polypodii, B. White.

## HYPHOMYCETES.

*DEMATIEI.*

SPOROCYBE.
bicolor, P.
MACROSPORIUM.
cheiranthi, Fr.
CLADOSPORIUM.
herbarum, Lk.

*MUCEDINES.*

ASPERGILLUS.
glaucus, Lk.
PERONOSPORA.
infestans, Mont.
ficariæ, Tul.
POLYACTIS.
vulgaris, Lk.
cana, B.
PENICILLIUM.
crustaceum, Fr.
OIDIUM.
aureum, Lk.
DACTYLIUM.
modestum, B. & B. White.

## PHYSOMYCETES.

*MUCORINI.*

ASCOPHORA.
mucedo, Tde.
MUCOR.
mucedo, L.

*SAPROLEGNIEI.*

SAPROLEGNIA.
ferax, Kutz.

## ASCOMYCETES.

*PERISPORIACEI.*

ERYSIPHE.
communis, L.
ASCOTRICHA.
chartarum, B.
EUROTIUM.
herbariorum, Lk.

*ELVELLACEI.*

LEOTIA.
lubrica, P.
PEZIZA.
*Aleuria.*
macropus, P.
badia, P.
onotica, P.
granulata, Bull.
*Lachnea.*
calycina, Schum.
HELOTIUM.
æruginosum, Fr.
BULGARIA.
sarcoides, Fr.

*PHACIDIACEI.*

RHYTISMA.
acerinum, Fr
STEGIA.
ilicis, Fr.
TROCHILA.
lauro-cerasi, Fr.
craterium, Fr.

*SPHÆRIACEI.*

TORRUBIA.
militaris, Fr.
CLAVICEPS.
purpurea, Tul.
HYPOMYCES.
chrysospermus, Tul.
HYPOCREA.
rufa, Fr.
NECTRIA.
cinnabarina, Fr.
XYLARIA.
hypoxylon, Grev.
carpophila, Fr.
USTULINA.
vulgaris, Tul.
POLYSTIGMA.
rubrum, P.
DOTHIDIA.
podagrariæ, Fr.
graminis, Fr.
CUCURBITARIA.
laburni, De Not.
SPHÆRIA.
acuta, Mong.

## MYXOMYCETES.

BADHAMIA.
utricularis, Bull.
FULIGO.
varians, Sommf.
SPUMARIA.
alba, Bull.
STEMONITIS.
fusca, Roth.
CLATHROPTYCHIUM.
rugulosum, Wall.

ENTERIDIUM.
olivaceum, Ehr.
RETICULARIA.
lycoperdon, Bull.
PERICHÆNA.
decipiens, B. & Br.
ARCYRIA.
punicea, P.
LYCOGALA.
epidendrum, Bux.

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## V.—LIST OF LEPIDOPTERA

### RHOPALOCERA.

PIERIS.
brassicæ, L.
rapæ, L.
napi, L.
ARGYNNIS.
Selene, Schiff.
Aglaia, L.
VANESSA.
urticæ, L.
Atalanta, L.
cardui, L.
PARARGE.
Egeria, L.
Megæra, L.
SATYRUS.
Semele, L.
EPINEPHELE.
Ianira, L.
Hyperanthus, L.
CŒNONYMPHA.
Pamphilns, L.
THECLA.
quercus, L.
rubi, L.
POLYOMMATUS.
Phlœas, L.
LYCÆNA.
Artaxerxes, Fab.
Icarus, Rott.

### HETEROCERA.

#### *SPHINGES.*

CHŒROCAMPA.
porcellus, L.
SMERINTHUS.
populi, L.
MACROGLOSSA.
stellatarum, L.
TROCHILIUM.
crabroniformis, Lewin.

#### *BOMBYCES.*

SAROTHRIPUS.
undulanus, Hb.
HYLOPHILA.
prasinana, L.
NOLA.
confusalis, H. S.
NEMEOPHILA.
russula, L.
plantaginis, L.
ARCTIA.
caia, L.
SPILOSOMA.
fuliginosa, L.
menthastri, Esp.
HEPIALUS.
humuli, L.
ORGYIA.
antiqua, L.
PŒCILOCAMPA.
populi, L.
BOMBYX.
rubi, L.
SATURNIA.
pavonia, L.
DREPANA.
lacertinaria, L.
falcataria, L.
DICRANURA.
furcula, L.
vinula, L.
LOPHOPTERYX.
camelina, L.
NOTODONTA.
dictæa, L.
dictæoides, Esp.
dromedarius, L.
PHALERA.
bucephala, L.
ASPHALIA.
flavicornis, L.

#### *NOCTUÆ.*

BRYOPHILA.
perla, Fb.
DEMAS.
coryli, L.
ACRONYCTA.
rumicis, L.
DILOBA.
cæruleocephala, L.
LEUCANIA.
lithargyria, Esp.
HYDRŒCIA.
micacea, Esp.
XYLOPHASIA.
rurea, Fb.
CLOANTHA.
polyodon, Clerck.
NEURONIA.
popularis, Fb.
CHARÆAS.
graminis, L.
LUPERINA.
testacea, Hb.
cespitis, Fb.
MAMESTRA.
brassicæ, L.
APAMEA.
basilinea, Fb.
unanimis, Tr.
CARADRINA.
quadripunctata, Fb.
RUSINA.
tenebrosa, Hb.
AGROTIS.
saucia, Hb.
exclamationis, L.
NOCTUA.
glareosa, Esp.
augur, Fb.
c-nigrum, L.
brunnea, Fb.
dahlii, Hb.
baia, Fb.
neglecta, Hb.
xanthographa, Fb.
TRIPHÆNA.
ianthina, Esp.
fimbria, L.
orbona, Hufn.
pronuba, L.
AMPHIPYRA.
tragopogonis, L.
MANIA.
typica, L.
PANOLIS.
piniperda, Panz.
PACHNOBIA.
rubricosa, Fb.
TÆNIOCAMPA.
gothica, L.
incerta, Hufn.
stabilis, View.
pulverulenta, Esp.
ORTHOSIA.
suspecta, Hb.
macilenta, Hb.
ANCHOCELIS.
rufina, L.
litura, L.
CERASTIS.
vaccinii, L.
SCOPELOSOMA.
satellitia, L.
XANTHIA.
circellaris, Hufn.
CIRRHŒDIA.
xerampelina, Hb.
CALYMNIA.
trapezina, L.
POLIA.
chi, L.
DASYPOLIA.
templi, Thnb.
CLEOCERIS.
viminalis, Fb.
MISELIA.
oxyacanthæ, L.
AGRIOPIS.
aprilina, L.
PHLOGOPHORA.
meticulosa, L.
APLECTA.
nebulosa, Hufn
CALOCAMPA.
vetusta, Hb.
exoleta, L.
solidaginis, Hb.
CUCULLIA.
umbratica, L.
HABROSTOLA.
tripartita, Hufn.
PLUSIA.
chrysitis, L.
iota, L.
pulchrina, Haw.
gamma, L.
HYPENA.
proboscidalis, L.

#### *GEOMETRÆ.*

RUMIA.
luteolata, L.
METROCAMPA.
margaritaria, L.
ELLOPIA.
prosapiaria, L.
SELENIA.
bilunaria, Esp.
ODONTOPERA.
bidentata, Clerck.
CROCALLIS.
elinguaria, L.
EUGONIA.
alniaria, L.
HIMERA.
pennaria, L.
PHIGALIA.
pedaria, Fb.
AMPHIDASYS.
betularia, L.
BOARMIA.
repandata, L.
TEPHROSIA.
crepuscularia, Hb.
GNOPHOS.
obscuraria, Hb.
DASYDIA.
obfuscaria, Hb.
ZONOSOMA.
punctaria, L.
ACIDALIA.
bisetata, Hufn.
aversata, L.
CABERA.
pusaria, L.
exanthemata, Scop.
HALIA.
vauaria, L.

EMATURGA.
atomaria, L.
BUPALUS.
piniaria, L.
HYBERNIA.
rupicapraria, Hb.
leucophæaria, Schiff.
aurantiaria, Esp.
marginaria, Bork.
defoliaria, Clerck.
ANISOPTERYX.
æscularia, Schiff.
CHEIMATOBIA.
brumata, L.
boreata, Hb.
OPORABIA.
dilutata, Bork.
LARENTIA.
didymata, L.
multistrigaria, Haw.
cæsiata, Lang.
olivata, Bork.
viridaria, Fb.
EUPITHECIA.
succenturiata, L.
subfulvata, Haw.
nanata, Hb.
vulgata, Haw.
minutata, Gn.
assimilata, Gn.
tenuiata, Hb.
lariciata, Frr.
abbreviata, St.
rectangulata, L.
THERA.
variata, Schiff.
HYPSIPETES.
sordidata, Fb.
MELANTHIA.
bicolorata, Hufn.
ocellata, L.
MELANIPPE.
tristata, L.
sociata, Bork.
montanata, Bork.
fluctuata, L.
ANTICLEA.
badiata, Hb.
nigrofasciaria, Göze.
CAMPTOGRAMMA.
bilineata, L.
TRIPHOSA.
dubitata, L.
CIDARIA.
siderata, Hufn.
miata, L.
corylata, Thnb.
truncata, Hufn.
immanata, Haw.
suffumata, Hb.
prunata, L.
populata, L.
fulvata, Forst.

EUBOLIA.
plumbaria, Fb.
CHESIAS.
spartiata, Fues.
rufata, Fb.

*PYRALIDES.*

SCOPARIA.
cembræ, Haw.
dubitalis, Hb.
murana, Curt.
HERBULA.
cespitalis, Schiff.
ENNYCHIA.
cingulata, L.
SCOPULA.
lutealis, Hb.
PIONEA.
forficalis, L.

*PTEROPHORI.*

MIMÆSEOPTILUS.
plagiodactylus, Sta.
ALUCITA.
hexadactyla, L.

*CRAMBI.*

CRAMBUS.
pratellus, L.
tristellus, Fb.
culmellus, L.
PHYCIS.
subornatella, Dup.
APHOMIA.
sociella, L.

*TORTRICES.*

TORTRIX.
corylana, Fb.
viridana, L.
ministrana, L.
LEPTOGRAMMA.
literana, L.
PERONEA.
ferrugana, Tr.
DICTYOPTERYX.
Lœflingiana, L.
MIXODIA.
Schulziana, Fb.
SCIAPHILA.
subjectana, Gn.
virgaureana, Tr.
penziana, Thnb.
CAPUA.
favillaceana, Hb.
PHOXOPTERYX.
unguicella, L.
myrtillana, Tr.
EPHIPPIPHORA.
similana, Hb.
COCCYX.
tædella, Clerck.
RETINIA.
pinivorana, Zell.
STIGMONOTA.
coniferana, Ratzb.
DICRORAMPHA.
politana, Hb.

CATOPTRIA.
ulicetana, Haw.
TORTRICODES.
hyemana, Hb.

*TINEÆ.*

LEMNATOPHILA.
phryganella, Hb.
EXAPATE.
congelatella, Clerck.
DIURNEA.
fagella, Fb.
SEMIOSCOPUS.
avellanella, Hb.
MICROPTERYX.
Seppella, Fb.
NEMOPHORA.
Swammerdammella, L.
ADELA.
viridella, L.
SWAMMERDAMMIA.
griseocapitella, Sta.

CEROSTOMA.
radiatella, Don.
costella, Fb.
HARPIPTERYX.
xylostella, L.
DEPRESSARIA.
liturella, Hb.
ARGYRESTHIA.
nitidella, Fb.
conjugella, Zell.
pygmæella, Hb.
Brochella, Hb.
CEDESTIS.
farinatella, Dup.
Gysselinella, Dup.
GRACILARIA.
alchimiella, Scop.
BUCCULATRIX.
ulmella, Mann.

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## VI.—LIST OF MOLLUSCA.

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A. FRESHWATER SPECIES.

PISIDIUM.
pusillum, Gmelin.
UNIO.
margaritifer, L.
LIMNÆA.
truncatula, Mull.

B. LAND SPECIES.

ARION.
ater, L.
hortensis, Fer.
LIMAX.
maximus, L.
agrestis, L.
arborum, B.-Ch.
VITRINA.
pellucida, Mull.
ZONITES.
cellarius, Mull.
alliarius, Miller.
nitidulus, Drap.
purus, Alder.
radiatulus, Alder.
crystallinus, Mull.
fulvus, Mull.
var. Mortoni, Jeff.
HELIX.
aculeata, Mull.
aspersa, Mull.
nemoralis, L.
hortensis, Mull.
arbustorum, L.
concinna, Jeff.
hispida, L.
var. subrufa, Moq.
rotundata, Mull.
rupestris, Drap.
pygmæa, Drap.
pulchella, Mull.
var. costata, Mull.
BULIMUS.
obscurus, Mull.
PUPA.
umbilicata, Drap.
var. edeutula, Moq.
(?) marginata, Drap.
VERTIGO.
substriata, Jeff.
edentula, Drap.
var. columella, Von Mart.
BALEA.
perversa, L.
CLAUSILIA.
rugosa, Drap.
var. Everetti, Miller.
,, tumidula, Jeff.
laminata, Mont.
COCHLICOPA.
lubrica, Mull.
var. viridula, Jeff.
CARYCHIUM.
minimum, Mull.

## VII.—LIST OF VERTEBRATES.

*Those that occur within the Municipal Boundaries are marked thus, *.*

### I. BIRDS.

*Those that nest in the district are marked thus, †.*

† * Song-thrush.
† * Missel-thrush.
* Redwing.
Fieldfare.
† * Blackbird.
* Common Dipper.
† * Redbreast.
Blackcap.
Garden-warbler.
Golden-crested Wren.
† * Willow-wren.
Wood-wren.
† * Hedge-sparrow.
† * Great Titmouse.
* English Coal Titmouse.
† * Blue Titmouse.
* Common Creeper.
† * Common Wren.
* Pied Wagtail.
* Grey Wagtail.
† * Spotted Flycatcher.
† * Swallow.
† * Martin.
* Sand-martin.
† * Greenfinch.
Hawfinch.
† * Common Sparrow.
† * Chaffinch.
† * Linnet.
Common Bullfinch.
† * Yellow Bunting.
† * Sky-lark.
† * Common Starling.
Common Jay.
† * Jackdaw.
Hooded Crow.
† * Rook.
† * Common Swift.
Common Kingfisher.
* Cuckoo.
Barn Owl.
Tawny Owl.
* Sparrow-hawk.
† Peregrine Falcon.
† Common Kestril.
* Common Heron.
† * Ring-dove.
† * Partridge.
† Capercaillie.
† * Land-rail.
Lapwing.
† Woodcock.
* Black-headed Gull,

[The Herring Gull and Redstart have been observed since the above list was compiled.—ED.]

### II. MAMMALS.

* Common Bat.
* Long-eared Bat.
* Hedge-hog.
Mole.
* Common Shrew.
Fox.
Weasel.
Stoat.
* Common Seal.
* Porpoise.
Roe-deer.
* Squirrel.
* Common Rat.
* Common Mouse.
* Long-tailed Field Mouse.
* Red Field Vole.
* Water Vole.
* Common Hare.
* Rabbit.

### III. REPTILES AND AMPHIBIANS.

Slow Worm.
Viviparous Lizard.
Common Newt.
* Frog.
* Toad.

### IV. FISH.

* Minnow.
* Allis Shad.
* Pike.
* Salmon.
* Sea Trout.
* Common Trout.
* Sharp-nosed Eel.
* Lampern.
* Flounder.

FEBRUARY 4TH, 1886.

F. BUCHANAN WHITE, M.D., F.L.S., President, in the Chair.

NEW MEMBERS.

The following were nominated :—

Mr John M'Gregor, Melville Street; Mr Robert Wright, Balhousie Street; and Mr John Robb, Athole Street.
Mr F. H. White, Annat Lodge, was elected.

DONATIONS.

The following were intimated :—

Specimen of a rare Perthshire plant *(Hieracium senescens)* from the Breadalbane mountains—from the Rev. E. F. Linton, Sprowston Vicarage, Norfolk; barn owl—from Mr J. Robertson, Kinnaird, per Mr J. S. Grant, Ballinluig.

The following papers were read :—

(1.) "*Notes on some Rare Perthshire Birds lately placed in the Museum.*" By Colonel H. M. Drummond Hay, C.M.Z.S.

(2.) "*Life and Works of Charles Darwin.*" By Mr James Coates.

[These papers are unavoidably held over for the present, but it is hoped that the first at least will be printed in next part of the Proceedings.—ED.]

MARCH 4TH, 1886.

## *ANNUAL MEETING.*

F. BUCHANAN WHITE, M.D., F.L.S., President, in the Chair.

### NEW MEMBERS.

The following were elected:—

Mr John Macgregor, Melville Street; Mr Robert Wright, Balhousie; and Mr John Robb, Athole Street.

The following were nominated:—

*As Ordinary Members.*—Mr Matthew, Walnut Grove; Miss Macdonald, Kinfauns Gardens; Mr James Lochead, solicitor, Blairgowrie; Mr D. S. Lowson, M.A., head-master of Blairgowrie Public School.

*As an Associate Member.*—Mr J. M'Bryde, jun., Dunkeld, recommended by the Council.

### DONATIONS.

The following donations were announced:—

*Perthshire Collection.* A buzzard—from Sir R. Menzies, per Mr J. Macdonald, Rannoch Lodge; a grouse—from Mr Wedderburn of Birkhill; mineral and rock specimens—from a friend, per Dr B. White; water vole—from Mr Wood of Freeland; raven—from Mr J. Robertson, jun., Kinnaird.

*Index Collection.* Minerals—from a friend, per Dr B. White.

### REPORT OF COUNCIL.

The Council, in presenting its Nineteenth Annual Report, is again able to congratulate the members on the flourishing condition of the Society.

During the past Session 7 ordinary meetings have been held, and 16 papers were read, in addition to several shorter contributions. The average attendance at the meetings was 33, being a slight increase on former years,—the greatest number being 60 at the January, 1886, meeting; and the least 20 at the November, 1885, meeting.

During the past Session 29 new names have been added to the roll of the Society as ordinary members and 1 as a corresponding member, making a total membership of 327, including 2 Honorary, and 9 Corresponding Members, and 9 Associates. The total shews a decrease of 2 compared with last year, but this is to be accounted for by the roll from which last year's return was made up containing many names which had to be removed owing to the death of some and the resignation or removal from the district of others.

Seven excursions were made during the past year, an eighth one arranged by the Council having to be postponed owing to wet weather. The Council take this opportunity of thanking the gentlemen who most kindly granted the members permission to go over their estates, or who otherwise assisted in making the excursions successful and pleasant.

The Council has held 7 meetings during the year.

The Museum continues to attract a considerable number of visitors, about 5000 having visited it during the year, bringing up the total number of visitors since the opening in December, 1883, to about 13,000. As in former years, the Council has had pleasure in granting the use of the Lecture-Room to other Associations for meetings and courses of lectures.

The Council trust the members will continue to take an ever-increasing interest in the welfare and prosperity of the Society, so that the coming year may shew even greater marks of progress than any that have yet preceded it.

### REPORT OF THE TREASURER.

BY MR JOHN STEWART.

The income of the Society for the year amounted to £95 11s 1d, and the expenditure to £90 5s 11d, leaving a balance in favour of the Society of £5 5s 2d.

### REPORT OF THE LIBRARIAN.

BY MR JAMES COATES.

There is but little to report about the Library, as it remains very much *in statu quo*, and that little cannot on the whole be described as an advance. Scarcely any books have been added since last report, and the number of readers is under that of former years. It can scarcely, however, be expected that this state of matters can be improved in the present condition of funds, as, in order to maintain interest and vitality, it would be necessary to keep up a constant supply of new books. In the case of a scientific, more than any other description of library, it is essential to keep pace with the times. To this end an adequate Library Endowment Fund would be necessary, and although there seems no prospect of attaining this at present, there can be no other means of placing the Library on a progressive basis.

### REPORT OF THE CURATOR.

BY COLONEL H. M. DRUMMOND HAY.

In tendering my report as Curator, I am glad to inform you that since this time last year the several departments, though slowly, have steadily progressed, and that the Museum still continues to be a source of attraction not only to visitors at a dis-

tance, but to those nearer home, many of whom coming, as we know they do, for information's sake, and not for mere curiosity, we may hope do not go away disappointed. This I may say the more confidently, having received the most gratifying approval of the system in which the Museum (as on entirely local and educational grounds) is being carried out from Professor Flower, of the British Museum, and Canon Tristram, most competent judges, both of whom made a most minute inspection of it; and I may in passing mention that Professor Flower was particularly pleased with the Index Collection and its arrangement.

With regard to the Perthshire and Basin of the Tay Collections, there have been various additions made in most of the departments.

In the Geological Section there is still a good deal to be done. In the Ornithological—more particularly under my charge—there have been several very rare and valuable additions made both to the birds and the nests and eggs. These I have lately brought under your notice, and therefore will not dwell on much now, further than to say that, since addressing you at the last meeting on this subject, I have had notice of another rarity recently shot on the Tay by a punt-gunner near Errol, which I have secured for the Society. This was *Chenalopex Egyptiaca*, the Egyptian Goose, a bird which only of late years has been admitted into the lists of British and Continental birds, and to which exception is even now occasionally made on the plea that the specimens, though killed at large, or apparently in a wild state, had probably escaped from waters in parks and pleasure grounds, where they had been bred and fostered. So many instances of their appearance have occurred, and in so many different localities, and more particularly in flocks of such numbers,—eighty having been seen together on one occasion in Hampshire, and many in different parts of Southern Europe,—that such men as Temminck and Gould have not hesitated in admitting it into their lists of European birds, and Yarrell includes it among the British; and as several instances have occurred of its having been got on the Tay, as well as the Earn, in severe winters like the present, I think the Society may be congratulated on the possession of a Tay-shot specimen.

With regard to the nests and eggs, a very large and valuable addition, as already reported, has been made through the indefatigable exertions of Mr J. Macdonald, keeper to Sir Robert Menzies at Rannoch Lodge. I may here state that the Society is much indebted to Sir Robert for the very great interest he has always taken in the increase of the Society's collections, which he has so much promoted through the assistance of his gamekeepers both in Rannoch and Strathtay.

In the Icthyological Department we have had some interesting additions, and I would particularly mention two beautiful casts, the one of a salmon, the other a shad, both from the Tay—the latter opposite Seggieden, sent to me by Mr Geo. Pitcaithly. The casts are by Mr P. D. Malloch, High Street, Perth, who deserves much credit for the life-like and artistic execution of his work; and were the Society enabled to obtain a collection of all the fish of the Tay basin in the same style it would be a most invaluable one. But I must state, that if the Society wish to carry out the original idea of obtaining and placing in their Museum a full collection of the fauna of the district, without which it cannot be said to be perfect in the educational light so much at heart, they must be prepared to make up their minds to building an addition, and that very shortly, as otherwise it will be of no use going on any more at present in the increase of our collections; for even as it is, in the very department we are speaking of, there are packages of fish for want of space unopened. The same want of space dwells in the ornithological department as well, and the difficulty of displaying in any way effectively the eggs and nests recently received, when they come to be arranged, which they will have to be shortly, is a problem difficult to unravel.

The present Museum room cannot contain more cabinets, and they are as full as they can possibly be; so that in many instances duplicates have continually to be taken out to make room for specimens not represented, thereby entirely (in respect to the birds) breaking that chain of locality, sex, and stage of plumage so desirable to have exemplified, and which was one of the great aims of the Society to attain.

### REPORT OF THE EDITOR.

BY MR H. COATES.

The only publication issued during the past year was the annual part of the "Proceedings" as usual.

### MONCREIFFE MEMORIAL MUSEUM FUND.

REPORT BY DR F. BUCHANAN WHITE, TREASURER OF THE FUND.

The Moncreiffe Memorial Museum Fund, the object of which was to carry out the scheme repeatedly advocated by the late Sir Thomas Moncreiffe when President of the Society, and which was raised, after his lamented death, in commemoration of him, having been now all spent, I, a short time ago, placed the books and papers relating to it in the hands of a Committee of the Council, for the purpose of having them audited. As the auditors will lay a statement before you, it is unnecessary for me to enter into particulars.

REPORT BY MR JAMES COATES, AUDITOR OF THE FUND.

The income, which amounted to £3591 5s 8d, was detailed as follows:—Amount of subscriptions, £1495 13s 11d; donations received from Duncan's Trust, £500; bazaar receipts, £1559 11s 11d; amount of deficit subscribed by Messrs Pullar, Brown, and Coates, £35 19s 10d. The expenditure, which showed a sum of £3591 5s 8d, comprised:—Buildings Account, £2040 14s 2d; furniture, cases, &c., £787 3s 4d; books and bookbinding, £205 3s 5d; specimens, carriage, &c., £205 10s 4d; printing, law, &c., £96 3s; bazaar charges, £244 5s 4d; sundry cash payments, £12 6s 1d.

On the motion of Mr A. LUMSDEN, the reports were unanimously adopted.

ELECTION OF OFFICE-BEARERS FOR 1886-87.

The following were elected office-bearers for the ensuing year:—

F. BUCHANAN WHITE, Esq., M.D., F.L.S., *President.*

Sir ROBERT MENZIES, Bart.,<br>
R. D. PULLAR, Esq., F.C.S.,<br>
R. DE BRUCE TROTTER, Esq., M.D., L.R.C.P.E.,<br>
JOHN YOUNG, Esq., C.E.,<br>
} *Vice-Presidents.*

S. T. ELLISON, Esq., *Secretary.*<br>
JOHN STEWART, Esq., *Treasurer.*<br>
Colonel H. M. DRUMMOND HAY, C.M.Z.S., *Curator.*<br>
JAMES COATES, Esq., *Librarian.*<br>
HENRY COATES, Esq., F.R.P.S., *Editor.*

R. BROWN, Esq., C.E., R.N.,<br>
W. BARCLAY, Esq.,<br>
W. ELLISON, Esq.,<br>
} *Councillors.*

On the motiou of Mr A. COATES, a hearty vote of thanks was given to the retiring office-bearers for their services during the past year.

## ANNUAL PRESIDENTIAL ADDRESS.

BY DR F. BUCHANAN WHITE.

In returning thanks for the honour you have again conferred upon me by re-electing me to the responsible office of President, I think I may congratulate the Society on the state of affairs that the Reports, which you have just heard, show. The attendance at the meetings, and the number and quality of the papers read thereat, show a decided improvement. On the other hand, we have no superabundance of pecuniary wealth, though—thanks to the generosity of several members—we are free from debt. That our energetic Curator has cause to renew, with increasing vehemence, his complaint of the want of more Museum space, is in one respect satisfactory, as it shows that the supply of specimens coming in is still good; and though it is unfortunate that we cannot at present exhibit these to the best advantage, that is a defect that will doubtless be some day remedied.

In the address that I had the honour of giving you at this time last year, I ventured to lay before you a scheme for an enlargement of the Museum, pointing out how very necessary it was that more space should be obtained, if our collections are to fulfil the object for which they had been begun.

In doing so I endeavoured to show that while the whole scheme might be carried out for about £1500, yet that two-thirds of that sum would enable us to put up the necessary additions to the building, and to furnish it so far as to relieve the strain upon our present Museum space. In doing so I did not attempt to guess where the money was to be found, nor can I do so upon the present occasion. As, however the Museum is one of the most potent weapons we have for promoting the objects of the Society, I have little doubt but that the funds will be eventually raised, and, as a step towards that desirable end, I propose devoting part of this present address to a consideration of some of the uses of the Museum.

On former occasions a good deal has been said about its utility as a means of public education,—that is, the instruction of those visitors who enter the building with but little knowledge of natural history. On the present occasion I wish rather to direct your attention to the mode in which the Museum is, or may be made, useful to the most learned naturalist as well as to the seeker after elementary knowledge.

Alluding to last year's address, the scientific journal *Nature* says:—"An appeal is also made for further specimens for the Perthshire collection of natural history—an appeal which we trust may meet with adequate response, for, apart from the general public benefit of local museums as centres of education throughout the country, they are of universal scientific importance when they are made the depositories of specimens of the natural history, past and present, of their respective neighbourhoods. But to be of the fullest value in this respect they must be made as complete as possible."

Now, in the first place, it is desirable to enquire what is to be understood by "as complete as possible." At first sight completeness would seem to have been attained were a single specimen of every animal, plant, or mineral, that is, or has been, found in the district, to be placed in the Museum, for this would form an object-index of the local zoology, botany, and geology, and be satisfactory evidence (so far as it went) of the occurrence of the various species. Should we adopt this view of "completeness," and form our collections on these lines, it is perhaps possible (though I doubt it) that our present Museum space would be sufficient, but I cannot suppose for a moment that any of our members are inclined to think that such collections could be called complete.

Let me endeavour then to sketch out what are some of the conditions by which perfect completeness may be reached, and consequently to show that to attain such perfect completeness more Museum space is absolutely

necessary. Restricting my remarks to the two departments of zoology and botany (on the present occasion I will say nothing about the geology), it is clearly evident that, though a single specimen of a species is a sufficient voucher for the occurrence of that species in the district, it cannot be sufficiently illustrative of the species.

For the proper illustration it is necessary that there be a series of specimens showing not only the adults of each sex, the various stages of growth, and the seasonal changes, but also, so far as it is possible, the mode of life. The number and character of the specimens necessary to show all these will vary not only according to the group, but even according to the species, and it is not possible to enter into particulars just now. But, even after we have obtained all the examples necessary for this purpose, we shall still be far short of perfect completeness. Another series of specimens—not necessarily, however, including all the states and conditions alluded to above—is desirable for illustrating the distribution in the area over which our researches extend. Perthshire and the basin of the Tay have been sub-divided into thirteen districts,—not arbitrarily, but according to the geological nature and drainage system,—and to illustrate the distribution properly, specimens of each species from all these districts, or from as many as it occurs in, should be preserved in the Museum.

Some persons may think that the object to be attained is not commensurate with the labour and money that must be expended, and that a few specimens from any one part of the county would be amply sufficient for the purpose. But if there be any that think this, let me endeavour to show them that their idea is a mistaken one, and that in the interests of science, and for several reasons, it is of great importance that a series of specimens from several parts of the area should be obtained and preserved.

In the first place, such specimens, properly authenticated, are vouchers for the occurrence of the species, and, as such, are of value in exhibiting, in the most forcible manner, the distribution of the species.

In the infancy of the study of natural history—not so long ago—little importance was attached to the question of the native country of a species, much less to its distribution throughout the world. Of late years naturalists have begun to see that much light may be thrown not only upon the past history of species, but upon their origin and relationship, by a careful study of their distribution. In large and metropolitan museums the distribution of regions and countries can be illustrated ; in smaller and provincial museums the distribution in counties and divisions of counties.

It may be thought that if the former and greater distribution is shown, all the information that is necessary will have been obtained, but the fact is, that if the causes of the wider distribution are to be accurately determined, it is in great measure by a careful study of the distribution in the smaller areas ; hence the importance of a county collection illustrating the local distribution.

It may be argued that in illustrating the distribution in Perthshire we are merely illustrating the distribution of an isolated district, and that as we do not show the distribution in the areas north and south, east or west, of our county, our labour will to a great extent be in vain, since the area is not wide enough to yield sufficient data for a solution of the problem. To a certain extent this may be true, though (as I will presently try to show) we have in Perthshire many facilities for investigating the laws that govern distribution. We must remember, however, that the areas bounding us have or will have museums founded much on the same plan as ours, and that these, with ours, will afford the philosophic naturalist the material absolutely necessary for elucidating this and other problems. It is, therefore, clearly our duty so to form our Museum that it may, so far as is possible, contribute to an increase of human knowledge—knowledge not in the sense of mere education, but in the acquisition of new facts.

I have said that Perthshire offers many facilities for the study of the laws which govern the distribution of species. A glance at the map, which I have here, will show that the physical features of the county are by no means uniform. The map shows the districts into which Perthshire has been divided. In the first place, we have two great sub-divisions, which correspond not only with the geological formations but with the mean altitude above sea-level. The smaller of these sub-divisions belongs geologically to the Old Red Sandstone formation, and is essentially the Lowland part of the county, very little of it attaining, much less surpassing, 1000 feet elevation above sea-level. The other and larger sub-division belongs to the Silurian formation, and is the Highland part of the county, comparatively little of it being below 1000 feet elevation, and most of it considerably above that height. To speak more definitely, I may state that the county (or rather the area which for natural history purposes we call the county) contains 2457 square miles. Of these about 743 belong to the Old Red Sandstone area, and 1714 to the Silurian. Of the Old Red Sandstone, or Lowland, area, about one-fifteenth only is above 1000 feet altitude, while of the Silurian not less than 1329 square miles surpass this altitude. It is also worthy of note that, as may be supposed, the Lowland or Old Red Sandstone area is essentially the cultivated one, while the other is for the most part necessarily uncultivated.

These, then, are the two great divisions, and that they are well marked can be readily seen any clear day from Kinnoull Hill or other convenient standpoint. The base of the Grampian Hills, stretching from north-east to south-west, plainly indicates the boundary between the two areas.

The districts—thirteen in number—are obtained by subdividing the two primary divisions according to the drainage system. It is not necessary to particularise them just now.

From this brief sketch it will be admitted, I think, that the physical features of Perthshire ought to affect the distribution of the fauna and flora. Of course the mere contour of the surface can play in itself but a secondary part, but as influencing the meteorological conditions, and as presenting the appropriate habitats, it is of great importance.

Before attempting to ascertain what the laws of distribution are, it will be necessary to find out what is the distribution of each species, and I now repeat, what I have already said, that in order to avoid any errors it is extremely desirable that properly-authenticated specimens should be obtained and preserved from every district. When that has been done, and not till then, we will be in a position to conduct satisfactory enquiries into the reasons for the ascertained distribution. In the meantime I may allude to some of the factors that probably more or less affect the distribution of species, and in thus alluding to these I am chiefly actuated by a desire to induce some of you to look into the matter and investigate it for yourselves, remembering that every fact ascertained and recorded will always be a help to the elucidation of the problem.

First, as to the *Petrology*, that is, the nature and mineral constituents of the rocks.

Some naturalists are inclined to doubt that on the whole there is much connection between the petrology of a district and its fauna and flora, and perhaps they are to a certain extent right. But that there is in some cases a distinct relation cannot be denied, and the extent of this in Perthshire is a subject that deserves investigation.

The connection between the petrology and the distribution of species must be considered in several aspects. For example, we must enquire as to whether the *mineral constituents of the rocks* have any bearing on the presence or absence of certain species. At present I am aware of one constituent only that has a distinct influence, and that is lime. A very few of our plants occur only upon limestone, and where that is absent it is of no use looking for them, though they are not always present where limestone occurs. While thus associated with limestone, a superabundance of lime does not seem to be essential for their growth, as they may be readily cultivated in ordinary garden soil. Of animals I am not aware that we have any that are thus restricted, though certain of our mollusca seem to be more abundant where limestone is present. Limestone, though it cannot be termed abundant in Perthshire, yet occurs here and there over a large area, and it is desirable that all the localities where it does occur should be carefully examined. Whether it is the presence of lime in the porphyritic rocks of the Sidlaw and Ochil ranges, and in the conglomerates of the Highland border, that makes them so much more productive than the sandstone rocks, is a matter for enquiry. It is at anyrate certain that some of our plants are almost or quite restricted to these, and they appear to be also richer in mollusca.

*The form and degree of hardness of the rocks* has a not unimportant bearing upon the distribution of species of plants at least. Rocks of a porphyritic nature like those of the Sidlaw hills, which form steep slopes and precipices, afford greater opportunities for species to safely establish themselves, than those which form or have been shaped into rounded masses, with few irregularities of surface. And when added to the precipitous character we find a greater or less tendency to disintegration, the most favourable conditions for plant life—and as we shall notice presently for other forms of life also—are afforded apart from the chemical and other influences. Hence probably the greater fertility of some parts of the porphyritic hills and of some of the Highland mountains.

The *temperature and the drainage of the rocks* are also matters that must be taken into account. In considering the former, and putting aside all question of the aspect,—since a locality that faces the sun must necessarily be more favoured than one that does not,—I am inclined to think that a porphyritic rock—be it from its colour or from its texture—absorbs more sun-heat than a sandstone rock, and that this is one reason why some sheltered nooks of the Sidlaws are so comparatively rich.

The effect of the form of the rocks upon the drainage, and hence upon plant life, is better seen in the Highlands than in the Lowlands, though examples can be found everywhere. A hill that is furnished with moderately damp rocks will—other things being equal—always be found more fertile than a hill with dry rocks. Hence it is that some of our Highland districts are so much more productive than others.

*Altitude above sea-level* is an important factor in the distribution of species, not only of plants but of animals.

Instead of altitude we might perhaps more appropriately say temperature, since it is by reason of the latter that altitude has any influence. An increase of altitude is similar, as regards the mean temperature, to an increase of latitude; as in both cases the mean temperature is diminished.

Altitude (or temperatnre) influeuces distribution in two ways. Some species cannot keep a footing where the temperature is lower than a certain mean. Hence they cannot live above a certain altitude. Others, while capable of living in the same temperature as those mentioned, are also capable of living in a lower, and hence can also find a home at a higher altitude. Yet another set can live at the lower altitude, but being for some reason less fitted to maintain their own in the struggle for existence, are driven to a higher altitude, where the struggle is less intense, and are hence in a great measure confined to the higher altitude. On the other hand, some species seem unable to survive when the temperature rises above a certain mean, and are hence necessarily confined to the higher altitudes. The influence of altitude upon distribution is not confined to plants only, but may be studied in many groups of animals, and we in Perthshire are very favourably situated for investigating the subject.

The connection of temperature with altitude leads us naturally to the question of the connection between *the meteorology* and the distribution.

Temperature as influenced by altitude in a wide sense we have already considered. We must not, however, lose sight of temperature depending upon local conditions. The influences also not only of the amount of the rainfall, but of the amount of moisture in the atmosphere;—of the extent of the snowfall, and the time during which it lies;—and of the prevailing winds, must all be taken into account, as there is but little doubt that each of these bears more or less directly upon the distribution of species.

The *river system* of the county as an agency in directing or controlling the distribution must not be overlooked. In addition to the action of running water as a carrier of species—not only of plants but of animals—from one place to another, the banks of the rivers frequently afford such conditions as are favourable for an increase in the production of individuals, and a consequent spread of the species up and down the stream. On the other hand, wide rivers present barriers to the distribution, though none of our streams are probably sufficiently large to be of much importance in this respect, unless it be the River Tay in its lower course, where it is several miles in width. As barriers to distribution, our mountain ranges are certainly more effective than the rivers.

The *distribution of the flora* is an important factor in the distribution not only of the fauna but of part of the flora itself. (Having discussed at some length, in my address as President in 1884 of the East of Scotland Union of Naturalists' Societies, some of the causes of the distribution of our plants, it seems unnecessary to enter into that subject just now more than has been already done in the preceding remarks.)

In alluding to the agency of one part of the flora upon the distribution of the other part, I refer of course to those species which are either parasitic upon other species, living or dead, or, like many woodland plants, are in a great measure dependent upon the protection afforded by other vegetation.

The effects of the distribution of the flora upon the distribution of the fauna must be very great. The range of all the animals which derive their food from plants—and more especially of those species which are dependent upon particular plants—is regulated by the distribution of the flora. But the effect does not terminate here, for since certain animals feed upon certain others, the causes that control the distribution of the latter will also control the distribution of the former. While the action of this agency is most potent and widely spread in the insects, yet all other departments of the fauna are more or less affected by it.

On the other hand, *the distribution of the fauna* acts in several ways on the distribution of the flora, as, for example, by the agency of insects in the fertilization of plants; by the agency of birds and mammals in carrying seeds; and also by the destruction of plants or of essential parts of them by animals. It must not be forgotten either that birds probably occasionally act as carriers of living mollusks.

Finally, there is to be considered the action of *human agency* on the distribution of species. Under this heading will come all the various effects of agriculture, of the reclamation of waste lands, of the formation of plantations and of railways, &c., &c., which, while preventing the increase or even causing the extinction of some species, are favourable to the introduction or increase of others.

In thus briefly discussing some of the causes which regulate the range of species, in order to show the necessity of a thorough investigation of the local distribution, I have abstained from giving illustrations under each heading. It would have been comparatively easy to have done so—and in fact I had the notes—had the limits of this address permitted. But since I have still to ask your attention to another and even more important reason why we should have in the Museum a large series of specimens, I have

thought it desirable to omit all illustrative remarks.

Before quitting the subject of the laws of distribution I should perhaps point out—though I daresay it is sufficiently evident—that while one or other of the various agencies to which allusion has been made, may be predominant in its effects on the distribution of a species, yet in most cases there will be more than one agent.

I now pass on to the other, and—on this occasion—final argument for the necessity of having in the Museum numerous examples of each species, collected in various parts of the county.

There is in every species a greater or less degree of instability; that is to say, no two individuals of a species are exactly alike in every respect, while in some species the extent to which individuals differ from one another is very great. To enable us, therefore, to properly understand a species, it is necessary that it be illustrated by a more or less numerous series of examples.

The variability of species is a subject that deserves much attention. In investigating this subject there are two questions to be considered :—

1st, The degree and nature of the variation.

2nd, The causes of it.

These again are capable of subdivisiou. Under the former we have firstly to ascertain to what extent our local specimens vary amongst themselves; and, secondly, to find out if, and how, they differ from specimens obtained in other districts or countries. Of these we can and ought to investigate the former for ourselves, but as in our Museum we have not the necessary material for comparison, the latter can scarcely be altogether satisfactorily studied by ourselves. At the same time this ought not to deter us from obtaining the specimens, for, as I have already endeavoured to explain, we form the Museum not for our own advantage merely, but for the benefit of naturalists in general. We must provide the material even though we cannot ourselves utilise it to the fullest extent.

The second division of this subject,—namely, the causes of the variation,—is a much more complex one. For its study, the circumstances and conditions under which the varieties occur must be studied aud compared with the like facts of the occurrence of typical individuals of other varieties of the same species. But though it is complex it is not to be doubted that, by the accumulation of facts and the careful study thereof, the problem will be some day solved.

Let me indicate briefly some of the lines in which variation runs in Perthshire species. Time will not of course permit of even a glance at all the groups of animals and plants, so I will confine myself to one or two.

Of the insects, the butterflies and moths present us with some marked forms of variations. It is usually thought —and in most cases with reason—that when northern and alpine examples of these insects differ from southern and lowland individuals of the same species, the variation is in the direction of a tendency to infuscation, or suffusion with black, often to such an extent that the markings are more or less obliterated. Such varieties are termed from their colour "melanic." This form of variation is so generally the case that it may almost be said to be the rule for northeru and alpine iusects to present melanic forms, and if there were no exceptions to it, it might be less difficult to discover the cause. As it is, various theories have been propounded, but none of them seem to me altogether satisfactory. The exponents of these theories have overlooked in great measure, or altogether, the fact that some of the northern variations are the very opposite of melanism,—the insects being invariably much paler in colour than their southern relatives.

In studying this subject in Perthshire,—and looking at the physiography of the county it will be admitted that we have a sufficiently wide field for profitable investigation,—we must first discover *whether* Lowland and Highland specimens differ, and *how* they differ ; and, in the second place, when a difference exists, whether it is sufficiently constant and universal as to entitle the specimens that show it to be considered as forming a local race. After this has been found out—and it is only by getting together numerous specimens from various parts of the county that we can expect to do so—it will be time to try to discover the causes that lead to the variation.

Another line in which variation runs is that of size. Some of our species are invariably smaller, others are larger, than southern individuals, and possibly we may find a similar difference between Highland and Lowland specimens. The shells of many of our mollusca are, I am inclined to think, rather larger than English examples of the same species. Is this the case? and, if it is, what is the cause ? Again, it is often thought that Highland specimens of some of our common plants have larger flowers, as well as brighter colours, than Lowland examples. Is this so, and what is the reason? As I have already said, a large series of local examples must be collected, and when we have got our data we can then begin to theorise.

But it is time to conclude this address, in which I regret I have been able merely to touch several subjects of high interest, since my primary object has been to endeavour to shew that our present duty is the aggregation of facts, and that an important method of so doing is the aggregation of properly-selected specimens iu the Museum. We must

remember that the Society exists not entirely for the mere amusement, nor even for the education, of its members. I do not wish for a moment to underrate these. The providing of innocent amusement must always be praiseworthy, and much more so the promotion of education. The latter, though with us necessarily confined to the natural sciences, will yet, by teaching and encouraging habits of observation and induction, surely result in otherwise benefitting both the individual and the community. But, however desirable these ends may be, they do not altogether form sufficient grounds for the existence of a scientific Society. To establish a true claim for existence, a Society must to the best of its ability take part in the general work of science, aud endeavour to increase the sum total of our knowledge of Nature.

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APRIL 1ST, 1886.

F. BUCHANAN WHITE, M.D., F.L.S., President, in the Chair.

NEW MEMBERS.

The following were elected :—

Mr Matthew, Walnut Grove; Miss Macdouald, Kinfauns Gardens; Mr James Lochhead, Blairgowrie; and Mr D. S. Lowson, Blairgowrie.

Mr John Wilson, teacher, Arngask, was elected an Associate Member.

DONATIONS.

The following were intimated :—

Perthshire birds—from Mr J. G. Millais; a blackbird, much spotted with white—from Mr James Young, Barnhill.

THE LATE MR STURROCK, RATTRAY.

Dr BUCHANAN WHITE read the following obituary notice :—

Before we proceed to the business of the evening, I have a very melancholy duty to perform. I have, with feelings of deep sorrow, to record the death of Mr Abram Sturrock. Ever enthusiastic in promoting its interests, the Society has lost in him one of its best members, while those of us who kuew him personally have been bereaved of a dear frieud. Before giving a short sketch of Mr Sturrock's history as a uaturalist—the only part of his history with which we, as a Society, are properly concerned—I wish to say a few words about his career apart from science, since the history of his life is so illustrative, not only of the nature and estimable qualities of the mau, but of some striking features of the national character.

Abram Sturrock was born in September, 1843, at Padanarum, a small village not far from Forfar. He was one of a family of fourteen, and though his parents had never any superfluity of worldly wealth, but rather the reverse, they contrived to give all their children a good education. Abram, says the friend to whom I am indebted for much of this information, often spoke of what his mother did, and was obliged to do, in order that her children should remain at school. His elementary education was received at Craichie School, about three miles from Forfar. From that he passed to the East Burgh School at Forfar, where

he served the requisite five years as a pupil-teacher. Leaving Forfar, he went to the Free Church Training College in Edinburgh, and acquitted himself there with distinction. During the time that he was a pupil-teacher, and also when he was at the Training College, he every year, in the holidays, hired himself out to some neighbouring farmer to do harvest work, and often performed a man's work with the scythe.

After two years in Edinburgh, Sturrock passed two years as assistant in Forfar Academy, which he left for Lunan Head School, where he remained three years; and then went to study for a while in Aberdeen University. From the University he went to take charge of a school at Ladybank, in Fife, staying there for three years, when he was appointed master of Rattray Parish School, a post which he held till his death. "Pending the appointment of teacher to Rattray Parish School" (writes my informant) "which resulted in the presentation of Mr Sturrock to that office—he being one of 70 applicants—the parish minister, the late Rev. W. Herdman (not the least talented of a highly-talented family), being greatly taken with Mr Sturrock's certificates, proceeded along with another gentleman to Ladybank, for the purpose of interviewing the candidate. Having been asked on his return what he thought of the applicant, Mr Herdman replied, 'He is a real man, one fit to be presented to Her Majesty the Queen.' How thoroughly characteristic of Mr Herdman's critical acumen, and how truly applicable the remark was to the subject of it, will be readily admitted by all who knew the two men, or by those who had even a slight acquaintance with Mr Sturrock."

Mr Sturrock had a very serious rheumatic illness about ten years ago. This was brought on by his brave endeavours to save the lives of two of his pupils who were drowned, and it is to be feared that his constitution never really recovered from the effects of this heroic act. He passed away, after an illness of three weeks, on the 13th of March, deeply regretted by all who knew him. He has left a widow and seven children.

I have not been able to ascertain whether Abram Sturrock showed any scientific tastes till he came to Rattray. It seems, however, probable that he had not turned his attention in the direction of science till his appointment to Rattray School, and that it was by Mr Herdman's advice that he took up botany. Mr Herdman (who was one of our members) was a good botanist, one of that class of parish ministers (of whom, unfortunately, we have very few in Perthshire at the present day) who interest themselves in the botany of their parishes, and of whom, along with Mr Herdman, the Rev. Dr Barty of Bendochy, Rev. Dr Stevenson of Coupar-Angus, and at a former period, the Rev. Mr Liston of Redgorton, and Rev. Mr M'Ritchie of Cluny, were conspicuous examples. Mr Herdman urged Sturrock to study botany. "But where shall I begin?" said Mr Sturrock. "Begin!" exclaimed the minister, "Why, parse the Lochee Brae" (a piece of common at the schoolhouse door). And that he "parsed" that and all the district round, we, his fellow-labourers, well know.

At what date I had first had the pleasure of meeting Mr Sturrock I am not sure. The Society had an excursion to Craighall on 2nd July, 1874, and this was very probably the first occasion on which we met. He was elected a member of the Society on December 2nd, 1875, and was a member of the Council from March, 1883, to March, 1885.

The special class of plants to which Mr Sturrock directed his attention for several years was the aquatic. He was probably led to do this by, in conjunction with the late Mr Robb, discovering in Loch Cluny the *Naias flexilis*, a plant at that time known only, so far as the British Isles are concerned, as an inhabitant of one lake in Ireland. This discovery was made on August 13th, 1874, and that day may be said to have inaugurated the long and successful series of explorations of the lakes of the district, which Mr Sturrock carried out, and which resulted in the discovery of several plants with which his name will be for ever associated.

In the neighbourhood of Blairgowrie, and between that place and Dunkeld, there are about a dozen small lochs. That the margins and waters of some of these were rich in plants had been well known for a long time. But that they were anything like so rich as they are was not suspected till Mr Sturrock began a systematic investigation of them. Most patiently did he work them over and over again till he had become thoroughly acquainted with their contents. Now, it must be remembered that aquatic botanising is a much more laborious proceeding than terrestrial plant-hunting, and that to work a lake successfully requires a large amount of perseverance under difficulties. But such perseverance meets with its reward, and part of Sturrock's reward was the discovery of two plants which have been named after him—the *Potamogeton Sturrockii* and the *Chara fragilis, var. Sturrockii.* The natural orders to which these plants belong were especial favourites of Mr Sturrock, and it is amongst them that his best work was performed, and his chief discoveries made. Many of the species belonging to these orders are exceedingly closely related, but by dint of hard study our friend had made himself very well acquainted with them, and I believe that no other botanist in Scotland had anything like a similar knowledge. I may add that his

discoveries led to his being visited by several eminent botanists (one of them a Norwegian); as well as to correspondence with others. Besides exploring the Blairgowrie series of lochs, Sturrock explored some other lochs in Perthshire and Forfarshire with successful results.

Though thus devoted to aquatic plants, he did not neglect the other groups. Latterly, at my suggestion, he had taken up the brambles. In proposing to him the collecting of the *Rubi* (brambles) in his district, I did not suggest that he should also study them. This group of plants is admittedly a most difficult one, and I thought that, to begin with at least, he would be content with merely collecting specimens. But it is eminently characteristic of the man that he not only collected specimens with the greatest enthusiasm, but commenced to study them in down-right earnest. Had he been spared to us, I believe that very soon he would have acquired an intimate knowledge of these difficult plants.

Mr Sturrock did not, unfortunately, put in print, so frequently as might have been desired, the valuable observations that he made. The reason for this was chiefly, I think, a desire to do a thing thoroughly and exhaustively when he did do it, and he thus delayed, thinking that some additions might be made to his knowledge of the subject. Thus he had promised me to give papers to the Society upon the botany of the Blairgowrie lochs and upon the botany of the Muirton Wood, but he always asked for more time until he was satisfied that no other discoveries were to be made. The above-mentioned Muirton Wood was a favourite resort of Mr Sturrock, and he found there some very remarkable species. In it that lovely and rare plant, the *Linnæ borealis*, grew, but was supposed to be extinct. One day, however, Sturrock, in company with our fellow member, Mr Barbour, rediscovered it, and, though naturally undemonstrative, could not refrain from manifesting, both vocally and muscularly, his great delight.

In this brief sketch I have necessarily omitted many details, but I think that enough has been said to make it apparent that Abram Sturrock's characteristics as a botanist were not only great enthusiasm and perseverance, but a desire to know all about, and an ability to discriminate, the object he was studying. He was not a mere plant-collector, but a scientific botanist. As a man, he was eminently companionable, sympathetic, and lovable; and I, amongst many others, will miss him more than words can express.

One word as to his collection. Owing principally to his donations, our herbarium is probably richer than any similar one elsewhere in specimens of the local Naiadaceæ, Characeæ, and Batrachian Ranunculi, all of them being represented by numerous and excellent examples. In the other groups there are also numerous specimens collected and presented by him. These were given by himself, but I am now authorised to say that his own private collection, and notes relating to it, have been generously presented to the Museum by Mrs Sturrock, who rightly thinks that the gift will be highly appreciated by her late husband's fellow-labourers in the field in which he did so much good and enduring work.

On the motion of the President, the following resolution was unanimously agreed to:—"That the Society has heard, with great regret, of the death of Mr Abram Sturrock, a member who has done so much to further the objects for which the Society was founded; that it moreover desires to express its respectful sympathy with Mr Sturrock's family in the irreparable loss that they have sustained; and that a copy of this minute be sent to Mrs Sturrock."

[On the suggestion of Dr White, a sum of money was subscribed by members of the Society to erect a headstone in memory of Mr Sturrock.

The following papers were read:—

1. "*The Gall-making Diptera of Scotland.*" By Professor J. W. H. Trail, F.L.S.

2. "*Perthshire Botany in the Seventeenth and Eighteenth Centuries.*" By Dr F. Buchanan White, F.L.S.

[The Council hopes to be able to publish these papers on some future occasion.]

MAY 6TH, 1886.

R. D. PULLAR, Esq., F.C.S., Vice-President, in the Chair.

NEW MEMBER.

Mr John Purves, Tullypowrie, Grandtully, was elected.

DONATIONS.

The following were announced :—

One large swan, two young fox cubs, and one mountain hare—from Sir Robert Menzies, Bart.; two tawny owls—from Lady Helen Macgregor, Edinchip; and one blackbird, spotted with white—from Miss Wood, Freeland.

EXHIBITIONS.

Mr H. Coates exhibited the following :—

1. A specimen of the horse-mussel *(Mytilus modiolus)*, from the Firth of Forth, containing a pea-crab. This little crab is frequently found living within the shell of the live mussel, and formerly it was supposed to act as sentinel, and to warn its host of approaching danger. This zoological myth formed the subject of allusions both by Cicero and Pliny, and has also formed the theme of modern English poetry. The reason why the crustacean chooses such a habitat does not seem to be quite understood.

2. A specimen of *Mya truncata*, a bivalve which lives buried in the mud, through which it extends a breathing tube. Attached to the shell was the horny covering which envelopes this breathing tube.

The following papers were read :—

1. "*The Life History of the Frog.*" By Mr James Stewart, L.D.S.

2. "*The Ocean and its Currents.*" By Mr R. Brown, C.E., R.N.

The following is an abstract of part of Mr Brown's paper :—

The surface of the earth may be marked off into three great areas—First, the Continents, covering roughly five-sixteenth's of the earth's surface, and having an average height of 900 feet above the level of the sea. Second, an abysmal region, with water of not a less depth than 1500 fathoms, covering 8-16ths, or one half of the earth's surface, the average depth of which is three miles. There is a region between these two called a border or transitional region covering 3-16ths of the earth's surface, and connecting the three great elevated plateaux of the Continents with the great submerged plain of the abysmal regions. In the border region deposits are now being laid down which are chiefly made up of the *debris* of the adjacent Continents—deposits resembling in almost all respects those out of which the sedimentary rocks making up the present Continents must have been formed in past ages.

In the abysmal areas there are here and there small volcanic islands, rising as great cones from the bottom of the sea, sometimes capped with coral reefs, but there are in those areas no traces of Continental rocks; indeed, it is extremely unlikely that any Continental land ever existed in these abysmal regions during past ages, and the deposits uow forming in them, far from the present Continental lands, have, so far as is known, no analogues in the geological series of rocks. While there is no evidence that Continents ever existed in the areas now composed by the abysmal regions, the ocean, on the other hand, has, in past times, flowed over nearly every portion of the Continents. What are now Continents have been broken up into islands of great or small size, and many islands, like Britain, Japan, the Phillipines, Australia, &c., at different periods of time formed parts of the existing neighbouring Continents. Wide seas have thus been formed over the land areas of past geologic times. Those seas, probably, never have had a depth nor an extent comparable with the depth and extent of the present great oceanic basins, but they have often had a depth of many hundreds of feet, aud were frequently filled with pure oceanic waters.

The breaking up of the land in this way has been among the chief factors in the distribution of climate in the past as well as at the present time; for by diverting equatorial oceanic currents, or by cutting them off from high latitudes, a given fauna or flora has been able to flourish in widely different latitudes on the surface of the earth. Of the five great areas into which the oceanic waters are usually divided by geographers, the Arctic and Autarctic Oceans are but little known, impassable barriers of ice having been met with wherever an attempt has been made to penetrate into them. Of the other three oceanic basins, the Atlantic, Pacific, and Indiau Oceans, much real, accurate, useful, and important information has been acquired in late years. The length of the Atlantic basin, cousidered as exteuding

between the Arctic and Antarctic circles, is close upon 8000 geographical miles.

The greatest depth found in the recent soundings of the *Challenger*, which was that of a limited depression about 85 miles north of St Thomas in the West Indies, is 3857 fathoms, or about 4·4 miles. Except in the neighbourhood of its coast lines, and in certain shallower areas, the floor of the basin in its widest part seems to be at a depth of 2000 to 3000 fathoms. The central portion of the principal basin of the North Atlantic, however, is occupied by a plateau of irregular shape, of which a considerable part lies at a less depth than 2000 fathoms.

The Pacific Ocean is the largest expanse of water in the world, covering fully a third of its surface, almost one-half of the water surface. It extends through 133 degrees of latitude, or, in other words, it measures 9180 miles from north to south. Its area has been estimated at 67,810,000 square miles. The Pacific is considerably more than all the land surface. The weight of the earth, assuming that its mean density was 5·6 times that of pure water, would be, in round numbers, 6000 trillions of tons. The coast line of the Pacific and Indian Oceans, taken together, amounts to only 47,000 miles; whilst that of the Atlantic alone measures 55,000—the smaller ocean making up for its less extent by its numerous inland seas of smaller size.

The drainage area of the Pacific is estimated at 8,660,000 square miles; while that of the Atlantic amounts to more than 19,000,000. The chief reason for the disparity is that only 500,000 of square miles of the American Continent drain into the Pacific — the remaining 6,500,000 being connected with the Atlantic river systems, and it is estimated that only 1·7th of the area of the Asiatic Continent drains into the Pacific. The Asiatic division of the Pacific river system is very much more extensive than that of the American, and includes many streams of great size and commercial importance. In the north, the Amoor is more than 2000 miles long, and it has many tributaries. Its drainage is calculated at 90,000 square miles. The Hoang-Ho has a length of 2600 miles; and the Yang-tse-Kiang measures 3200 miles, from its source to the sea.

Of the rivers which discharge their waters into the Atlantic, the Mississippi alone discharges a greater quantity of water than the eight principal rivers of Asia. The Mississippi, with its branches, affords a greater amount of inland navigation than all the streams great and small which irrigate Europe; and the Plata, in that respect, claims a superiority over the collective rivers of Africa. But the American rivers not only surpass those of the Old World in length and volume of water—they are so placed as to penetrate everywhere to the heart of the Continent. The estuaries of all the great American rivers open to the eastward, and it should be observed that the position of the great rivers of the New World is but one example of a physical arrangement which is common to the whole globe; for it is remarkable that in the Old World as well as in the New, no river of the first class flows to the westward. The depth of the Indian Ocean averages about 2500 fathoms, increasing to 3000 fathoms, or 3·4 miles.

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JANUARY 21ST, 1886.

## CONVERSAZIONE.

A conversazione of members and their friends was held in the Society's Rooms. Notwithstanding the wintry weather, there was a fair attendance. The chief attraction was the Museum, where there was abundant evidence that during the past year members in charge of the various departments had not been idle. Every available wall and floor space was occupied by cases, the majority of which were quite filled. As usual, the collection of Perthshire birds, and also that of birds' nests and eggs, were greatly admired.

In the Lecture-Room, the cases of Perthshire insects were displayed round the wall, while in the centre a number of microscopes were exhibited by various members, under the general charge of Mr John Campbell. In these were shown microscopic objects of interest in all departpartments of natural history. Perhaps the most admired were a series of sections of the local crystalline rocks, shown by aid of the polariscope. In this room also Mr R. Brown, C.E., R.N., exhibited a large collection of Parisian views by the aid of the graphiscope. In the Library, Messrs R. D. and A. E. Pullar exhibited a most interesting series of photographic transparencies through the megalethoscope.

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## SUMMER SESSION, 1886.

The following Excursions were made :—

### May 20th.

1. *To Invermay.*

This, the first excursion of the season, was well attended. By the kind permission of Mr Grant, the banks of the River May within the policies of Invermay were investigated. Starting from Forteviot Station, the party proceeded along the course of the river to Invermay. Between the station and the entrance lodge several interesting and rare plants were observed, including *Potentilla reptans*, *Veronica montana*, *Chrysosplenium alternifolium*, *Cerastium arvense*, *Stellaria nemorum*, &c. Within the grounds of Invermay, several other interesting species were noticed, such as the Wood Betony (*Stachys Betonica*); the curious little Moschatel (*Adoxa moschatellina*), which is more abundant there than we have observed it elsewhere in Perthshire; and *Veronica collina*, with very small but intensely blue flowers.

But though these and other plants were seen in flower, many species were only in bud, and hence the rocky banks of the river were not so beautiful as they would be in the course of a few weeks. For the same reason the number of plants observed was not so great as it would otherwise have been. When about half-way through Invermay the weather unfortunately broke, and the rest of the excursion was made in a pelting rain, which was not only extremely unpleasant, but what was worse, prevented so much work being done as would otherwise have been the case.

Reaching Ardargie, the road to Forgandenny was taken, and the River Earn crossed at the Boat of Forgan, not, however, without several desertions from the party. The hill road (across Callerfountain and Craigie) gave the botanists an opportunity of adding several other noteworthy plants to the day's list, including *Viola hirta*, *V. lutea*, *Vicia lathyroides*, *Montia minor*, *Cerastium tetrandrum*, and the rare mosses, *Grimmia leucophæa* and *Hypnum rugosum*. Setting aside the trifling disadvantage of having got wet to the skin, the members of the party all seemed to have enjoyed very much the first excursion of the season.

The number of flowering plants and ferns observed was about 160, so that the botanists had no great cause of complaint. The zoologists were less fortunate, scarcely an insect having been seen; and the mollusca being represented only by the common *Helix nemoralis*.

### June 12th.

2. *To Lake of Monteith.*

This excursion was to have been in conjunction with the Stirling Natural History Society, but from the alteration of the date (necessitated by the state of the weather) none of the members of the Stirling Society were able to be present, which was very much regretted by the Perthshire Society.

The Lake of Monteith, the beauty of which commands the admiration of all who visit it, had not before been visited by the Society, as it seems more inaccessible for a day's excursion from Perth than it really is. Thanks to the kind liberality with which the landed proprietors of Perthshire give facilities to the Society for the prosecution of its scientific pursuits, there were no difficulties in the way of going where specimens could be obtained and observations made. For this the Society is much indebted to Mr Orr Ewing, the present tenant, and Mr Erskine, the proprietor of Cardross, and to Admiral Erskine of Lochend.

Starting from Port of Monteith Station, the road to the Great Wood of Cardross and Cardross Moss was taken. On the moss a number of interesting plants were found. Amongst these may be mentioned *Carex paniculata*, a large sedge not hitherto recorded from this part of the county, and remarkable for the large tussocks which it forms; one of the long-leaved sundews (*Drosera Anglica*), an interesting and pretty plant; *Andromeda polifolia*, one of the heaths, and a very rare plant in Perthshire; the lovely little cranberry (*Vaccinium oxycoccos*), with its red flowers; another sedge new to the district, *Carex limosa*, &c., &c.

The lake was reached near its south-west corner, and its shore followed in an easterly direction. Not very much was found on its southern shore except some specimens of the flesh-coloured orchid (*Orchis incarnata*) near Lochend. Passing Lochend, some time was devoted to the eastern shore of the lake, and here a number of interesting though not very rare plants were observed. Some of these deserve special notice. For example, the Water Lobelia (*Lobelia

*Dortmanna*), a plant which is always supposed to grow in at least several inches of water (sometimes several feet), only extruding its flowers above the surface, was found growing in ground which may have been recently submerged, but which must usually be only damp—a circumstance the more remarkable as the plant was preparing to flower. Not one but many specimens were observed. Another plant, the Fir Clubmoss (*Lycopodium selago*), which with us is usually confined to the hills, was also noticed, and deserves mention on account of the low altitude of the locality. On a grassy bank the Moonwort Fern (*Botrychium lunaria*) was found, and in marshy ground the above-mentioned flesh-coloured orchid and the butterfly orchid were rather common.

Passing the Port of Monteith, part of the north shore of the lake was examined, and gave evidence that it would well repay a careful search. One of the most notable plants seen here was the bistort (*Polygonum bistorta*), whose light pink flowers quite coloured the drier parts of a marshy meadow. Though admitted to be a native plant, in England and the southern half of Scotland, it is considered to be only an escape from cultivation north of Edinburgh, and as such it occurs here and there in Perthshire. But from the appearance of the plant and its surroundings we have no hesitation in accepting it as indigenous beside the Lake of Monteith. The purple loosestrife (*Lythrum Salicaria*), and a rather local sedge, *Carex teretiuscula*, were the chief other finds on the small part of the northern shore that could be examined in the time.

During the day upwards of 200 species of plants were observed. Of insects the occurrence of the rare *Coccyx distinctana* must be recorded. After a short rest at the comfortable Port of Monteith Hotel, the party returned to the station very well satisfied with the result of the day's excursion, and determined to return on a future occasion to complete the exploration of the lake and its historically-interesting islands.

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### June 26th.

3. *To Banks of Earn and Tay.*

Starting from Bridge of Earn, the north bank of the river was followed nearly to its junction with the Tay. Thence the party crossed the fields to near Inchyra Ferry, and went up the Tay as far Elcho. Then going inland some of the rocky knolls near Elcho were examined, after which the road to Perth was taken.

During the day upwards of 250 species of plants were noted, amongst which the following may be specially mentioned:—The Flowering Rush (*Butomus umbellatus*), a pretty pink-flowered plant, 2 to 3 feet high, which grows in soft mud. Though many botanists will not acknowledge this to be a native in Scotland, there seems to be but little doubt about its being thoroughly wild on the banks of the Tay. As strengthening this supposition, one of the larger sedges (*Carex acuta*) was found near the same place on Saturday. This plant has not been recorded north of Roxburgh on the east side of Scotland. Another interesting plant—the name of which is yet uncertain—was also found on the banks of the Tay, and will get, as it deserves, further attention.

Less rare than the above, but still of uncommon occurrence, are *Carex aquatilis*, *Lythrum Salicaria*, *Myosotis strigulosa*, *Trifolium striatum*, *Epipactis latifolia*, *Veronica montana*, *Geranium columbinum*, *Typha latifolia*, &c., &c. For the pleasure of seeing some of these the party were indebted to the veteran botanist, Colonel Drummond Hay of Seggieden, who met his fellow-members about the middle of the day.

The alteration that has taken place in the botany of Moncreiffe Pond during the last few years deserves notice. Formerly several very local Perthshire plants occurred there, such as *Ranunculus circinatus* and *Lemna trisulca*, but these have disappeared, having apparently been killed out by that pestiferous plant, the American water-weed (*Elodea Canadensis*).

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### July 3rd.

4. *To Tentsmuir.*

On this occasion the Society visited the wide range of moors and sandhills that lie on the southern side of the mouth of the Tay, and which is known as Tentsmuir. The excursion was in conjunction with the Natural History Societies of Dundee, Largo, and Kirkcaldy.

Tentsmuir is a tract of mossy moor; but in some places highly peaty ground several square miles in extent occur. The moor on the whole is fairly level, though, towards the estuary, lines of sandhills break the monotony of the level. Parts are or have been under cultivation, but the greater

portion is—save for two or three plantations—in its primitive condition, except that it has been more or less drained, and consequently to a certain degree spoiled as a botanical field. When not cultivated, the surface is covered with heather (of three kinds), large beds of the creeping willow, a scant crop of various grasses, and a great quantity of the sand sedge (*Carex arenaria.*) Nearer the sea, some of these give place to other plants, but over a large part of it they form the characteristic vegetation.

Leave to explore the grounds had been kindly given by Admiral Maitland Dougall and Mr Speedie. Starting from Leuchars, the vegetation of some sandy fields first attracted attention, as several local plants were conspicuous. The most prominent of these were the Greater Yellow Rattle (*Rhinanthus major*), a handsome plant with yellow flowers, and of decided local distribution. Others were *Teesdalia nudicaulis*, *Anthemis arvensis*, and *Cerastium arvense.* Passing on to the moor, various interesting plants were observed, amongst which may be noted *Veronica Anagallis*, frequent in the ditches, and the curious little All-seed (*Radiola linoides*).

About the middle of the moor the rarest find of the day was made, namely, the Coral-Root Orchid (*Corallorhiza innata*) a very curious and rare plant. After that, not much additional was found till the marshes near the sea were reached, except that the curious nest of the Eider Duck was found, and duly admired.

In the above-mentioned marshes and amongst the sand-hills on the shore several rare plants were seen. Amongst these were *Stellaria palustris*, which here perhaps reaches its northern limits in Britain; *Carex incurva ; Juncus balticus*, which attains in Fifeshire its southern limit in Britain; *Equisetum variegatum*, *Orchis incarnata*, &c.

During the day upwards of 170 species of flowering plants were observed.

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July 17th.

5. *To Craig na Caillich.*

This excursion, which began with a visit to Craig na Caillich (or Craig Chailleach) and neighbouring hills on July 17th, extended over several days, and included visits to Ben Lawers, Larig an Lochan, Ben Heasgarnich, and Craig Mhor. Most of the special Breadalbane plants were seen. A longer account of the excursion will be given hereafter.

August 18th.

6. *To White Moss, near Dunning.*

Lord Rollo having kindly given permission for the exploration of the White Moss, which is a small loch near Dunning, a boat was procured and placed on the loch by the kind services of Mr James Rollo, Baadhead, who had it carted to and from Perth. The White Moss is notable as being the only locality in Perthshire where *Potamogeton filiformis* and *Zunnichellia palustris* have been found. It was therefore anticipated that other rare aquatics might be found, a hope which was not realized. *Callitriche autumnalis* was got in the loch, and *Sedum villosum* near it.

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September 4th.

7. *To Lindores Loch.*

The Perthshire, Newburgh, and Kirkcaldy Societies took part in this excursion, and there was a very large attendance. The day's work was chiefly confined to an examination of the shores and water of the loch. In the marshes, which extend more or less all round it, several plants of great interest occur. Of these the most noteworthy is probably the narrow-leaved mace-reed (*Typha angustifolia*), which is a species that has been found in very few places in Scotland. It is abundant at Lindores, and seems to be increasing in quantity.

Other plants that deserve mention are the Great Spearwort (*Ranunculus Lingua*), Purple loosestrife (*Lythrum Salicaria*), Marsh Stitchwort (*Stellaria palustris*), and the Unbranched Bur-reed (*Sparganium simplex*). Two local plants that used to occur sparingly on the shores of the loch, seem to have disappeared, having been crushed out by other vegetation, These species are *Lycopus europæus* and *Chenopodium rubrum.*

The waters of the loch being much discoloured by minute algæ, were with difficulty examined for aquatic plants, and, in fact, as it was impossible to see much below the surface, all botanizing had to be done by means of the dredge. It is, therefore, probable that the aquatic flora has not yet been exhaustively examined. Amongst the species that were found were *Ranunculus circinatus*, *Callitriche autumnalis*, *Potamogeton crispus*, *P. prælongus*, *P. obtusifolius*, and *P. pusillus*, &c. Both the yellow (*Nuphar luteum*) and white (*Nymphæa alba*) water lilies occur, but the latter has been planted.